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The ELECTRICAL REVIEW

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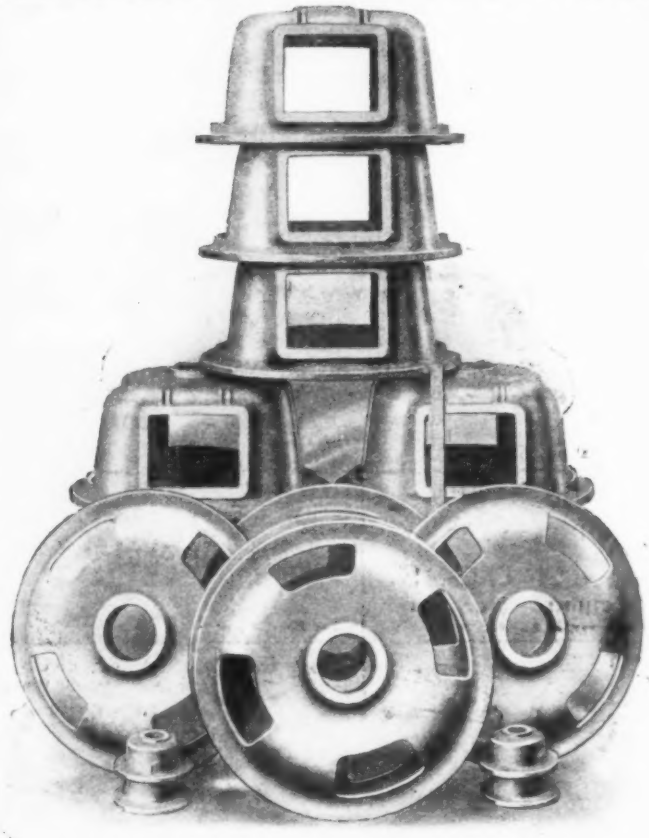

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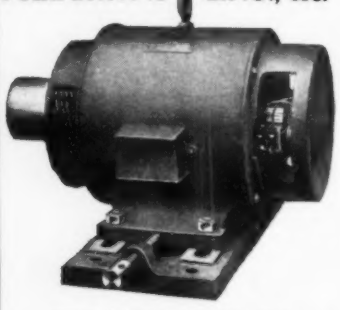

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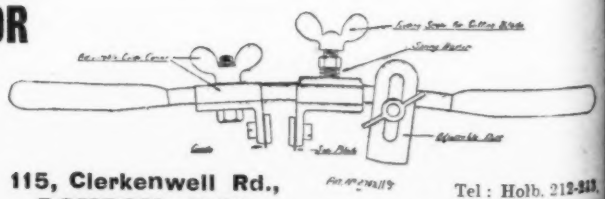

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First Impressions at Wembley.

FIRST impressions count for much in exhibitions as in personalities, and it is a matter for congratulation that, from whichever point of the compass the visitor approaches the electrical section of the Palace of Engineering at Wembley, he is at once impressed by the variety of the exhibits and the excellence of the display. After the many engineering and trade exhibitions of recent years there might be some excuse for thinking that Wembley could only offer a sort of conglomeration of all its forerunners, but this is certainly not the case. There is, at Wembley, that most elusive and desirable of all characteristics—a new "atmosphere." The things we have seen before appear in a new light, and the many exhibits now shown in public for the first time are much more interesting than might have been expected. What is the main element in this new atmosphere it is difficult to say, but there it is, and it portends success.

The two most striking features of the exhibits as a whole are their live interest and their admirable display. It is evident that the utmost care has been expended on the selection and arrangement of exhibits, and there is a noticeable absence of that haphazard crowding which, in the past, has rendered so many displays ineffective. Any electrical engineer who visits this section of the British Empire Exhibtion for the first time, filled with friendly anxiety as to whether "the thing has been done properly," will come away reassured. The exhibits are interesting, instructive, and impressive not only to electrical engineers of all classes,

but also to the general public, and it is very important that the layman's interest in matters electrical should be thoroughly aroused and maintained. The excellent work of the Electrical Development Association has borne good fruit, but there are millions of people in this country and from overseas who will realise for the first time, at Wembley, the achievements of and possibilities offered by electrical engineers and manufacturers. The status of the whole profession of electrical engineering will be raised by this exhibition, and the reputation of British firms will be greatly enhanced.

The interest and value of the exhibits have, in many instances, been greatly increased by the showing of the interior of apparatus, sections being made where necessary. Electric motors and batteries are cut in two, turbine covers are raised, pipes with instrument connections are shown in section, and so on. Everywhere, the policy is followed of showing visitors what is inside, and how it works. No better means could be adopted to demonstrate the excellence of design, materials, and workmanship. In the case of such apparatus as dry cells there are samples of all the materials used in their construction, and an impressive total they make. This idea might be followed more generally and, indeed, it could be extended to advantage by stating beneath each material the part of the Empire from which it is drawn. Coloured maps would convey the same information in more striking form, and would serve a useful purpose. The extent of our Empire, and the breadth of the field from which we draw the materials for our manufactures cannot be too widely advertised in these days, and this knowledge—vital to a sane appreciation of Imperial problems—could be driven home by individual firms to visitors, who cannot be expected to pore over official maps and statistics. The lesson which is so interesting in relation to different manufactures individually becomes dry and indigestible when presented in the form of charts and tables relating to all the products of a Dominion, Colony, or Protectorate.

Next to the instruction afforded concerning the manufacture of individual products, the visitor is engaged by the many useful comparisons between old and new apparatus, and between correct and incorrect applications of modern apparatus. Here again, we have a striking demonstration of progress achieved, and useful lessons in the proper utilisation of up-to-date equipment. Both of these ideas might well be developed by electrical exhibitors as a means of yet further improving their exhibits and incorporating new features which will bring visitors back to their stands again and again. What the railways have done by setting Stephenson's locomotive alongside the "Flying Scotsman," and what the ordnance firms have done by placing the field gun of the 'fifties alongside one used in the Great War, could be done more extensively than is at present the case by the electrical exhibitors. This country has a record second to none in the pioneering of electrical engineering from the earliest days. Why not demonstrate this fact by a liberal sprinkling of historical equipment? As for the other idea, that of demonstrating the proper use of modern equipment, what the Electrical Development Association has done in the way of demonstrating good and bad lighting might well be paralleled by other exhibitors. Thus, firms showing electric cookers could demonstrate with the aid of large-scale thermometers and watt-hour meters the economies to be effected by intelligent use of the apparatus. Similarly, the makers of motors could demonstrate by the same means the overload capacity of motors and the principles of correct selection and application of machines—with particular reference to the maintenance of high power factor and the economy of high-speed geared motors where applicable. These and other demonstrations of like nature would have the interest of novelty, and it is difficult to overestimate their educative value.

In making so many suggestions within the compass of one short article we would not have it thought that we are criticising adversely the splendid effort of British firms. On the contrary, this is, we are convinced, the best electrical exhibition that the world has yet seen, and our only desire is to see it better still and, in particular, imbued with increasing life and interest during the six months of its existence. Everyone, be he engineer or layman, will find at Wembley not merely something to interest him, but much. Also, the electrical apparatus on view extends far beyond the limits of the electrical section itself. Indeed, every part of the exhibition grounds and buildings bears witness—tangible, visible, and audible—to the omnipresence of electricity in all our daily affairs.

A Word for the Stand Attendant.

WE wish to make an appeal on behalf of those who "man" the electrical and engineering stands at Wembley. In the early days, however busy they may be, their lot will not seem so arduous as it is sure to be later when they "settle down" to the thought that the days will all be very much alike for many months. In many cases every care will have been taken to ensure their comfort, regular food and other accommodation, rest hours, relaxation, and relief from high-pressure operations and even from the monotony of the daily round, but it requires to be recognised by all in authority—and by visitors in particular may we say—that their lot is one calling for more than ordinary consideration. It is a six months' show, and none of us is likely to forget that. Experience has told many of us how absolutely killing is that "fed-up" feeling which creeps on one long before the end of an exhibition lasting only for three weeks or a month. Doubtless some such feeling will come over some at several periods during a business which lasts five or six times as long. It is no use blinking the fact that we shall depend for much of the success that Wembley exhibitors will derive from this great effort upon the service rendered by those who are in charge and in direct touch with the public. A wise division of duties, working two shifts per day, may prevent attendants from being overdone, but between now and October most will need to get right away from Wembley for a holiday. Managers, sales attendants, and other officials will not fail to recognise this in relation to themselves personally.

We may draw attention to a timely article appearing in this issue on "The Sales Demonstrator at the Exhibition."

It will not be forgotten that there will be no room for slacking on the part of anybody who wishes to get the best return on the exhibition outlay. We have had to write some very plain truths on this side of the subject in the past. May we hope that there will be no ground for complaint regarding unattended exhibits, discourtesies, and other peculiarities of the kind during our "residence" at Wembley? We may do much to prevent such things if we give reasonable thought to the ordinary effects of strain and monotony upon human temperament, nerves, and physical endurance.

I.E.E. Benevolence.

IT has so often been pointed out that electrical engineering is a comparatively young profession that we return to the subject with diffidence. But facts must be faced; and the fact that we wish to impress upon our readers is that youth is not perennial, even in a profession—that middle age creeps upon us almost unawares, and that advancing years bring with them their inevitable accompaniments of lessened vigour, greater liability to disease, and weakened powers of resistance to business worries. Moreover, the electrical industries are continually expanding and enrolling larger numbers of workers, thus increasing the risk of commercial and physical casualties in their ranks. The membership of the Institution of Electrical Engineers itself bears witness to this rapid growth, having increased from 7,000 to 11,000 in the past five years.

The obvious conclusion is that the amount annually disbursed by the I.E.E. Benevolent Fund must necessarily increase, not merely in proportion to the growth of the industry, but at a very much greater rate. To meet the increased demand the income of the fund must also expand, and as in many cases it will be necessary to make grants not merely for temporary relief, but in the form of pensions, the invested capital of the fund ought to be far larger than it is. Allowing for the fact that a large proportion of the members are in the junior grades, it remains beyond question that the number of contributors to the fund, and the total income, are deplorably meagre and utterly unworthy of an Institution of professional men which is almost the largest body of the kind in the Kingdom.

An appeal to the members was recently issued by the President, but the response to it has been very disappointing. It ought not to be necessary to appeal to members to make provision for their own fellow members, or the relatives of members who are in needy circumstances; but we feel impelled to draw attention to the miserably inadequate income of the fund, which last year *fell far short of the outgoings*. Surely the members of so distinguished a body will not allow this stigma to rest upon their Institution; electrical engineers individually are open-handed and sympathetic, and we are confident that when they realise the situation as a body they will not fail to fulfil the duty which rests upon their shoulders and make due provision for their own sick and needy.

B.E.S.A. Activities.

Every manufacturing nation now appreciates the benefits of standardisation, which, moreover, is of enormous advantage to the countries which from an engineering point of view are consumers; but hitherto, with certain important exceptions for which the International Electrotechnical Commission is mainly responsible, each country has laid down standards for its own citizens alone. There is, however, a tendency towards closer co-operation between the various standardising organisations, which has found expression up to the present by way of unofficial conferences of the secretaries, to discuss the questions of common interest. The second of these conferences was held in Switzerland, in July last year, and we recently received from Mr. C. le Maistre, C.B.E., secretary of the B.E.S.A., a copy of the trilingual report. Some 14 national committees were represented, and the proceedings were very harmonious and fruitful.

Such conferences bring the secretaries into close contact, and lead to the solution of many problems by subsequent correspondence which could otherwise be dealt with only by the formation of a costly international commission; they also help the various countries to appreciate each other's point of view.

The circulation of information in connection with the conferences is now a matter of routine. On the one hand, information of a general character is given without any intention of furthering agreement, but merely to help individual standardising bodies in their own work; on the other hand, information is circulated from Switzerland as a centre with a view to obtaining international agreement in specific cases, and in this case the greatest caution is exercised to ensure that nothing is disclosed to other committees without the direct sanction of the committee responsible for the particular work concerned. Thus the interests of the British manufacturer are efficiently safeguarded.

There is great scope for the study of nomenclature, symbols, specifications, methods of test, rating of machinery, &c., as well as of the procedure adopted in the various countries, the translation of technical terms, methods of securing the adoption of standards, exchange of information, and the furtherance of co-operation, and we have no doubt that industry in general will benefit materially by the ventilation of such questions at these unofficial conferences.

The Kelvin Lecture.

Mr. G. Semenza, who for many years has been in the front rank of Italian electrical engineers, and is President of the International Electrotechnical Commission, must be congratulated on the happy inspiration which led him to take the "Kelvin Law" for the basis of this year's Kelvin lecture; in his own country Mr. Semenza has had abundant opportunity for putting into practice the principle which is embodied in the well-known "law," and for observing how it must be modified to conform with the conditions of to-day. Obviously, no hard and fast rule can be followed in the design of overhead transmission lines, and Lord Kelvin never intended that his dictum should be regarded as the last word on the subject; in it he crystallised a great but simple truth representing a first approximation to the solution of a problem in technical economics, and there he left the matter.

Mr. Semenza, no doubt, took full advantage of the licence permitted to a lecturer when he proceeded to treat of other cases in the design of transmission lines which could be dealt with on similar lines; in point of fact, both these and the Kelvin law itself are particular cases of a mathematical principle which is of far greater antiquity. The lecturer was entirely at home in discussing these interesting problems, and we feel sure that his lecture will be found not only worthy of the great occasion, but also of immediate practical use to engineers.

The Position of German Electrical Companies.

As a result of the low value of the paper mark profits when expressed in gold marks, and in view of the prospective change-over of the accounts to a gold basis, all the German electrical companies are carrying forward the net profits earned during the past year instead of attempting to pay any dividend. We briefly mentioned the results of two German Siemens companies in our last issue, and further particulars are now to hand.

The directors of the Siemens and Halske Company state that the works were well provided with orders on the whole during last year. In many branches a decline in the orders became noticeable towards the end of the year; this applied to the foreign trade transactions where the prices obtained were not always favourable considering the increased costs of production. The active demand continued for automatic telephone equipment for public and private purposes, and plant for a total of 600,000 subscriber connections had been supplied and put into service. In electrical measuring apparatus the home demand diminished, but the export trade, at any rate that in high-class apparatus, was satisfactory.

The report of the Siemens-Schuckert Works Company states that the export trade in 1922-23 became more difficult, while the economic situation caused the inland electricity works to proceed slowly with installation extensions. On the other hand, the restriction of the natural coal resources stimulated efforts to further utilise the water powers. An active demand was manifested for overhead networks for all pressures. The large transformers for high pressure that were brought into service last year had justified, through reliable working, the confidence placed in them. In the manufacture of cables for heavy currents, a section of 49.6 miles of 50,000-volt single-core cable was delivered. Business in industrial installations suffered most from the occupation of the Ruhr. Very few orders were furnished by the German tramways, although foreign contracts were received.

According to recent dispatches from Berlin to the *Financial Times*, there have been large realisations of the Stinnes interests in the Siemens & Halske Co. and other companies since, so that it is now doubted whether the Stinnes estate is any longer the chief shareholder in these companies. Apparently Stinnes was hard pressed for ready capital just prior to his death, and his heirs have had to realise quickly in order to keep the rest of the undertakings running.

The Uses of Electricity Demonstrated at Wembley.

The E.D.A. Exhibit.

The production and use of electricity are exhibited at every stage within the confines of the British Empire display at Wembley. The manifold purposes to which it has been applied form an object lesson in its utility and advancement, impressive even if the great industry which has grown up around the work of the electrical pioneers had not also taken its place in the forefront of the British engineering exhibits which form so considerable a feature of the exhibition.

The largest concrete building in the world houses the engineer at Wembley; some five acres of the roofed space of the Palace of Engineering are occupied by the products of British manufacturers of electrical appliances. Here they have constructed, on land but a few months ago open to the sky, a complete electric generating station, surrounded by every machine, appliance and instrument employed to-day to produce, convey, and use the power which is so rapidly becoming the universal means to light, to heat, and to lighten labour.

Electricity in Service.

The electricity supply section of the electrical industry is represented at the Empire Exhibition by the "Electricity in Service" exhibit, situated in the North-West corner of the Palace of Engineering (Avenues 13 to 15, Bays 1 to 4), and reached by the "Faraday" and "Kelvin" gates.

This exhibit has been produced by the British Electrical Development Association on behalf of some 250 public supply undertakings; it constitutes a valuable co-operative effort for the guidance and information of the public in the position reached in different districts in regard to the use of electricity, its cost, and best method of employment. We are sure that no words of praise can be too high for this wonderful achievement of Mr. J. W. Beauchamp, Mr. W. A. Gillott, and their staff of assistants.

The exhibit, concerning which much has already appeared in our pages as the movement has made progress during the past 18 months, is of particular interest to every visitor, as it deals extensively with the use of electricity in the home, and touches problems of domestic comfort and management, to which no one can be indifferent nowadays.

The Electric House.

The display, within three minutes' walk of the Northern entrance (Wembley Park Station) to the exhibition, covers a space of 10,000 sq. ft., and comprises:—

A full-sized house, with representative rooms fitted with a complete range of modern and practical electrical appliances for lighting, heating, cooking, labour-saving, washing, and cleaning.

The house is designed to permit large numbers of visitors to inspect its electrical features in comfort, and it is adequately staffed with men and women willing to give information and not required to effect sales. The elevation and decorations of this building, designed by Messrs. Imrie & Angell, domestic architects, will suggest to visitors the radical change in the appearance of our cities which will follow when the use of light and heat without fuel and dirt has banished chimneys, and the labour and destructive drudgery of which they are a token.

A Place of Quiet.

An office and rest lounge is also provided within this section of the exhibition, fitted with every modern convenience for writing, use of telephone and reference books; it will prove a welcome place for rest or rendezvous, with a good view over a number of open displays of electrical material, where each use of electricity is illustrated in detail, and the apparatus of the leading makers shown under working conditions; here the visitor can examine and learn the proper use and cost of:—

Electric cooking range for home or restaurant.

Grills, kettles, ovens, toasters, liquid heaters and other portable "electrics" for culinary use.

Electricity in cleaning and housework, the suction dust-remover, washing machines for clothes, china and plate—the home laundry.

The fire "electric" in its varied forms, imitating the blaze of coal, warming with artificial sunheat or heating under automatic thermometer control.

The lamp in its thousand forms, with object lessons in its correct and incorrect use, its cost and the manner in which modern wiring and switching will double its usefulness and reduce its expenses.

Display lighting, the illumination of store windows, the electrical needs of the retailer.

Electricity in the workshop, its use for hardening, driving small machines, welding and soldering metals, melting glues and chemicals and the ever-lengthening list of workers' aids which electric power places in the hands of the amateur or commercial producer to-day.

Fresh air and refrigeration, the correct use and value of fans, ice-making, service lifts and the many appliances which go to make up the engineering side of the modern hotel or restaurant.

The Popular Kiosks.

The value of electricity in advertising is well brought out in this display by the employment of electrical demonstrators in kiosks, where simple and interesting work is carried out by means of electricity, and can readily be observed by visitors under powerful spot lighting, producing at once an attractive impression of the efficiency and cleanliness of the electric method, and of the value of electric lighting for display purposes.

Generally, the conception of the "Electricity in Service" section is to take the home as a centre, and as an object of the greatest interest to every visitor to Wembley; the use of electricity therein to-day has been elaborated, and is spreading outward from the home to the employment of the same power through the small industries, shops, distribution service and catering, which immediately centre around and associate themselves with the modern home in an urban community.

The Electric Farm.

The Electrical Development Association has another exhibit, displaying on a small but interesting scale the employment of electric power on the farm.

The electric farm, situated in the Eastern part of the grounds (North 18) and immediately adjacent to H.M. Government building, has been produced for the Association by Mr. R. Borlase Matthews, Wh.Ex., M.I.E.E., &c., who, as our readers know, has long been associated in a practical and advisory capacity with the employment of electric power in agricultural work.

This display exhibits amongst many processes the following of outstanding interest:—

The stimulation of egg-laying during the winter months by the employment of artificial lighting during a portion of the dark hours.

The hygienic and labour-saving method of milking cows by means of electricity.

The drying of hay in the rick by means of electrically driven ventilating fans, a method of great promise, rendering the farmer more independent of the weather and in many seasons able to avoid great loss.

Electrically-heated incubators, a full range of electric motors for operating churns, milk separators and vegetable choppers.

A windmill driving an electric generator for lighting and small power requirements where no public supply is available and demand may not justify the employment of oil or similar engines.

The Salesman Demonstrator at the Exhibition.

By J. O. KNOWLES, B.A.

THE experienced salesman is not always the "best seller" on an exhibition stand. His experience may even be in some ways a hindrance to him in adapting himself to the conditions of exhibition work. Even good men may be mentally "stiff" in changing their technique of selling to suit the special conditions, and it is not easy to "think things out" or to consider the principles of exhibition demonstration while in the midst of crowds. It is certain, therefore, that in the greatest of all exhibitions, various faults in manner and in technique will be observable among the salesmen on the stands.

A salesman in his ordinary journeyings meets his customers in their own offices, but at an exhibition the environment is quite different. The habits of a man in his own office are not those of the same man sightseeing among the stands, where he is out of the rut of his own routine. The salesman who has been called in from the road, and the buyer who is "on holiday" at Wembley will certainly have a fellow feeling—during the first week of the exhibition, when everything is new and the salesman is full of the energy of beginning in a new sphere. But when the difference in environment narrows down to the difference between one day and the next at the same exhibition, this frothy type of enthusiasm, arising merely from change of scene, will evaporate and leave a dullness as of ditchwater. The early buyer may then have to dig out a reluctant salesman from behind the morning newspaper, and in the evening there will be the monotonous thanksgiving—"Another day nearer the end of this ——— exhibition."

In the ordinary course of business, a buyer may see fifty travellers in a week, but he does not spend all the day talking—he has his business to attend to. At the exhibition the buyer has no daily work—he is a free man, unharassed by thought of an overflowing desk. Even if the buyer is not on holiday, he is at least away from his work, and of this fact two types of salesman will take undue advantage. One will pour streams of information into his (supposedly) empty head until the excess of this information over the capacity to receive becomes plain even to this type of salesman. The other type will be too friendly to say more than he need about his exhibit, and will canvass his buyers too frequently for one willing to be led away, metaphorically, to discuss anything but business, or literally, to visit the side shows. Between these two extreme types there is a mean—blessed is the man who keeps a fairly straight course, and still more blessed the man who knows to which extreme to steer when required.

While a salesman ordinarily selects the men he calls upon, at an exhibition the buyer chooses more freely. Instead of being induced to listen to some at least of the travellers who call upon him, he offers himself to the staff of certain stands as a victim—for a time. In many cases the buyer has the unusual opportunity of seeing the salesman talk to someone else before he leaves the crowd and actually walks on the stand. If the goods displayed interest him and the salesman's manner does not, he probably compromises by studying the goods from the stand rails, and moves on when the danger of being drawn into talk with the undesired salesman becomes too imminent. The salesman who is apt to buttonhole an unwilling listener is not more suited to exhibition work than he is to the steady cultivation of a district.

Time is equally limited in both office and exhibition, but the positions of buyer and salesman are reversed. In the office the buyer is thinking of the next man in the waiting room. At the exhibition there is no waiting room, and inconvenient times will happen when there are more buyers willing to listen than there are salesmen ready to explain. This is an unusual situation for the man accustomed to call on his buyers one by one, and the problem is complicated by the fact that all sightseers are not buyers. To separate the important from the casual visitor is less easy when there is a crowd on and round the stand, and at such times the tactless salesman may be seen alienating buyers to whom he has no time to speak at length.

When the salesman travels to see the buyer, he is "primed" for his call by the journey, long or short, to his customer's works. He has time to adapt his attitude to the known characteristics and interests of the buyer. At an exhibition, however, an interview is seldom arranged till it happens. The salesman loses the advantage of preparation, and in the necessity for immediate adaptation of one's conversation to the various types of visitors there are two large pitfalls and many smaller ones. There is the salesman who degenerates into a gramophone, repeating the same tale to every buyer, and there is the firm which does not know how and when to relieve its representatives from incipient staleness. An exhibition is kaleidoscopic, and the pace is fast.

On the road, a traveller may say: "I don't feel in the mood to call on So-and-so," and in some cases he would be right in not calling. One cannot be adaptable all the time without losing individuality. A salesman is not expected to be "all things to all men all the time"—except at an exhibition. Wembley will be an everchanging panorama for the visitor, but to the man who has demonstrated too long, all crowds are the same crowd—and to a visitor who has been bombarded with sales talk all day, all salesmen are the same salesmen. It is easy to test this by making a tour round a few stands in the busiest part of the day, to notice how many demonstrators speak to one man as if he were a crowd, losing individuality in a mechanical repetition of their "story."

Fresh surroundings are an antidote to staleness, and even the different aspects of the various offices visited by a salesman keep him from monotony. In an exhibition, nothing on the stand varies but the buyer. The same story has to be told all day in the same place for weeks on end. It is therefore necessary in a long-period exhibition to change the *personnel* at intervals. Fortunately, this is usually easy, because there are in every organisation of moderate size suitable men who can be spared to demonstrate exhibits, and these men can be spared for a short time more easily than for a month or more. These short-period assistants have innate qualifications which outweigh much inexperience of selling. They can generally be enthusiastic demonstrators, and it is a peculiar trait of human nature that when we are on a holiday excursion, we are reluctant to believe that this holiday can be tiring. This self-deception makes us shy of talking to anyone obviously more tired than ourselves for fear we are becoming really as tired as the other seems to be. So a demonstrator who has not lost his first delight in demonstrating is an attraction to a buyer whose curiosity is degenerating into satiety.

In the midst of the noise and the movement, the placards and the exhibits, it is a pleasure to speak with someone who can talk to you as if you and he were the only people within miles, and if he couples this faculty with a restrained enthusiasm and a knowledge of facts (not superlatives) about his exhibits, he need only indicate a seat to make the tired visitor his willing listener.

I am reminded that on one subject I have not said a word—and that is regarding the lady demonstrator and alternatively the buyer's wife, but as more than a word would be needed I must leave many things unsaid.

E

The Lighting of the Exhibition.

A Review of the General Scheme.

WITH the exception of the Amusement Park, the whole of the Exhibition is lighted with electricity. The design and supervision of the lighting scheme were entrusted to Commander Haydn T. Harrison, M.I.E.E., whose wide experience and fertility of resource ensured that it should be not only adequate for its purpose but also original in conception and first-class in execution. The chief object aimed at was to provide ample illumination without glare, and without detracting from the bold architectural features of the buildings; it was the desire of the exhibition authorities that beauty rather than brilliancy should be achieved, and that the sources of light should in no way be conspicuous. Hence, the services of Commander Harrison were retained early in 1923, to prepare and carry out schemes that would attain the desired end. These schemes have had to be considerably modified from time to time, owing to the pressing demand for space in all parts of the grounds, and to the desire of some of the Colonial and Dominion authorities to light their buildings in a more conventional manner, with the result that the whole of the work could not be completed in time for the opening of the exhibition However, so much of it as is in operation indicates the beauty of the results which will be witnessed in the course of a few weeks.

The immensity of the undertaking necessitated high-pressure distribution, and therefore alternating current has been used throughout, feeding incandescent gasfilled lamps, which have proved, after considerable research work on the part of the illuminating expert, to be most suitable for the purpose.

Flood Lighting.

It was desired that the frontages of the more important buildings should be flood-lighted, but it was important that no special structures should be employed for this purpose which might appear unsightly in daylight; Mr. Haydn Harrison therefore decided that all flood lights should be erected on the roofs of those buildings which could be used for the purpose. The roofs of many of the buildings, however, were unsuitable, and for this reason it was found necessary to carry out much of the flood lighting from abnormal distances, in some cases no less than 1,000 ft.; this meant that the projectors to be used must be capable of concentrating the beam of light within a very narrow angle of divergence. It was ascertained that by using low-voltage gasfilled lamps with concentrated filaments this could be done; the specifications that were issued for these projectors allowed for the use of 12-volt lamps, and required a concentration within four degrees, with a multiplying factor of 1,000. The makers of lamps and projectors loyally responded to these requirements, with the result that the projectors in use have a multiplying factor of more than 3,000, giving a candle-power of 350,000 c.p. when consuming 100 watts—a remarkable achievement. It is interesting to note that the efficiency thus obtained is considerably greater than would be possible with a small arc projector. One important advantage gained by the adoption of this system of flood lighting is that the shadows on the fronts of the buildings are in normal directions, and are not inverted, as often happens with flood lighting on customary lines.

In order that these powerful sources of light should not be visible to the public eye, it was decided that in no case should the rays reach a point lower than 10 to 15 ft. from the ground, and that the lower parts of the buildings should be illuminated by lamps on ground standards.

Colour Effects.

A beautiful effect is produced by gradually varying the colour of the flood lighting; this is accomplished by using three circuits, connected through a central dimming station with three sets of projectors, two of which are fitted with coloured screens. The magnitude of the dimming station will be realised when we add that it has to deal with 400 kW, as there will eventually be over 2,000 projectors of various descriptions.

The dimmer equipment was made by Messrs. Allen West & Co., Ltd., of Brighton, and is illustrated herewith (fig. 1). The equipment is suitable for handling a maximum load of 500 kW, reducing the voltage across the lamps by 40 per cent.—that is, from 240 to 140 volts per phase. Each equipment consists of three single-phase liquid regulators, insulated from each other and from the earth; the three regulators are mechanically coupled together, and are operated by means of the handwheel and gear seen in the foreground of the illustration. The electrolyte is cooled by a continuous circulation of water through pipes, and the controller is so constructed, under the makers' patents, as to ensure a natural circulation of the electrolyte. Each phase can deal with a maximum of 700 A continuously, and requires 600 gallons of cooling water per hour if used continuously up to its full capacity. An Allen West ironclad circuit-breaker, type "SM," provided with three overload and a no-volt releases, is used for isolating the dimmer from the supply when not required.

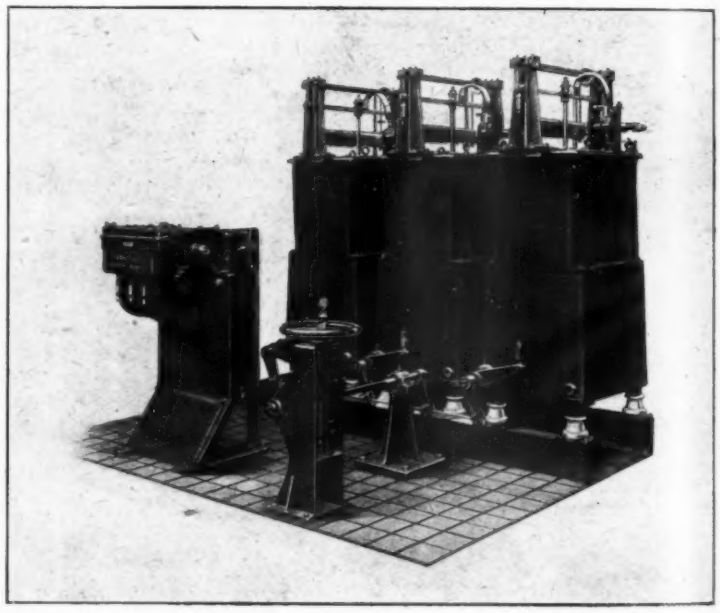


Fig. 1.—Allen West Dimmer Equipment.

General Lighting.

The ground lighting is effected by about 700 lanterns of special design, the most beautiful of which are spherical in form, representing a terrestrial globe, mounted on concrete columns specially designed by Major Ayrton, F.R.I.B.A., architect to the exhibition. In the case of these lanterns, which are two feet in diameter, and are

intended to give from 600 to 1,500 c.p., an evenly illuminated sphere of low brilliancy has been obtained by using flashed opal glass, specially chosen for the purpose; the excellence of the result must be seen to be fully appreciated. These lanterns were supplied by the General Electric Co., Ltd., of London.

In cases where appearance is not of so much importance, a simpler design of cylindrical lantern has been adopted; these lanterns are also of flashed opal glass, and were manufactured by the Electric Street Lighting Apparatus Co., of Canterbury. In other cases, where large areas have to be illuminated from a few points, high poles carrying lamps and reflectors which give an aggregate per group of 5,000 to 10,000 c.p. have been used.

The lighting of the artificial lake is not yet complete; owing to the large number of craft on the lake, and the beautiful gardens surrounding it, the original scheme of surface illumination only is being modified in order to secure the best results when viewed from the bridges and other points where the lake comes into full view.

Interior Lighting.

The general lighting of the Stadium and other vast buildings is carried out as far as possible by means of high-power gasfilled lamps, placed in the highest positions attainable, with the result that the sources of light are practically out of sight, and a very efficient general illumination is the result.

From 1,500 to 2,000 kVA will be used for lighting the grounds and the main exhibition buildings, all of which will be transformed into light by means of gas-filled lamps operating at a high efficiency, and concentrating their luminous energy on the main features of the exhibition. The flood lights alone will represent a maximum candle-power of 600,000,000 c.p., and the general lighting a diffused illumination of about 6,000,000 c.p. The details of the various apparatus used for the purpose, embodying as they do the most modern developments of illuminating science, are worthy of careful study, and will be dealt with at a convenient opportunity.

The bulk of the special fittings used were made by the Benjamin Electric, Ltd., of Tottenham; their reflector-fittings are installed throughout the Palace of Industry, the Palace of Engineering, the Stadium, and many of the other main buildings of the exhibition; they also manufactured the specially designed floodlights, the special fittings in the bandstands and for the colonnade lighting, and those for the ground lighting, besides the fittings used on many of the exhibitors' stands. But the details of these must be left for another occasion.

Lamps.

The lamps for all purposes have been supplied by various firms who are members of the Electric Lamp Manufacturers' Association. We understand that careful records will be kept of the performance of the various makes and types of lamps, which will no doubt add considerably to the data available on this subject.

Hydro-Electric Works in Sweden.—According to a paper presented by Mr. K. K'eman at the recent meeting of the Swedish Waterpower Association, the modern equipped waterpowers in Sweden at the beginning of 1923 represented about 1,325,000 h.p. and were increased by about 20,000 h.p. during the year. It was estimated that the production of these works in 1923 reached from 2,800,000,000 to 3,000,000,000 kW-hours, which is slightly more than in the high period of prosperity directly after the great war. At the present time power stations of a total of 72,000 h.p. are in course of construction. Of these, that of the Lilla Edet, on the Gota River, for 30,000 h.p., and the Lanforsen, on the Dal River, of 33,000 h.p., are expected to be ready in 1925 and 1927 respectively. Concerning the inter-Scandinavian Power Committee's technical committee, the author stated that the committee completed its work in 1923 with regard to the transmission of energy from Norway to Denmark. As a result of certain circumstances and the less favourable condition of Danish industries at the present time, the author stated that the question of transmission on a large scale did not possess the same actuality as was the case a few years ago.

Life in a One-Man Station.

By J. M. C. FIELD.

In these days of steam turbines and super-stations it may be refreshing to some to let their thoughts turn for a moment to those who are concerned with less pretentious undertakings.

There are many of us who have a peculiar hankering for a life of variety, and to these a job as the manager—engineer — secretary — clerk—switchboard-attendant—engine-driver — meter-reader — mains-mechanic—office boy to a small town supply undertaking may appeal.

The life is certainly not all honey, but I have found it far more interesting and attractive than the dull monotony of shift or departmental work in a larger station.

It may be surprising to some that quite a number of statutory undertakings are operated by one man only, with the assistance, perhaps, of a lad or two. I am referring, of course, to stations equipped with actual generating plant, and not merely sub-station gear.

Power load in these stations is practically non-existent, and therefore the "shift" duties usually consist of starting-up the "bus," generally a suction gas or semi-Diesel engine, at about 3 p.m., charging the battery till dusk, continuing the run through the evening, and shutting down at about 11 p.m. This work is often entrusted to the lad assistant.

The mains, usually overhead, do not give much trouble, and the installation of a new "service" is but the work of a morning.

The summer months, with daylight saving, give one a chance for a good holiday and an easy time for a month or two, to make up for the ravages of the winter. However, plant overhaul takes some considerable time, as it is generally necessary to dismantle one engine completely, clean it, fit new parts where necessary, and re-assemble it.

In addition, mains extensions are undertaken, and battery repairs are sometimes necessary.

Canvassing for new consumers is the most hateful job. In a certain sleepy country town, where I had the privilege of starting up a new undertaking, I called at a house, where the door was opened by an individual who appeared to be most cordial. On my mentioning the words "electric light," however, the door was slammed in my face. He was the manager of the gas works.

At another house, where I was delivering circulars stating that "the supply would shortly be commenced," the good lady informed me that she could not possibly have the electric light installed, "as she had not got the gas in yet." This appeared to her to be a most ample and conclusive reason for retaining the oil lamps. On my departure, however, she remarked to her husband: "The envelope would come in for something," so I was rewarded by being able to be of some assistance to her.

Obtaining and fixing up wayleaves is a very irksome job, and meter reading is nearly as bad, but only coming once a quarter, it is soon forgotten about.

After diving into a coal cellar or scrambling into an attic, one is not in one's best humour for explaining the reason of a minimum charge and other unwelcome subjects to cantankerous customers. The generosity of more reasonable beings, however, makes one develop an almost curate-like propensity for tea and buns.

Those who are sick of the monotony of departmental work in a large station, or those who, having won a prize in a hospital competition, can therefore finance their own undertaking and want an interesting occupation, might do far worse than tackle such a job as has been described.

Mica and Micanite Insulation.—III.*

Specifications and their Interpretation: Essential Simple Analyses and Technical Tests of Mica to ascertain its Suitability for the use for which it is required.

By ARCHIBALD A. C. DICKSON.

Grading Mica.

THERE being a great deal of misapprehension as to the signification of the denominations: Extra Extra Special, Extra Special, Special, A1, and Nos. 1, 2, 3, 4, 5, 5½ and 6, applied to the grading or sizing of slab or block mica and splittings used and adhered to by miners at the various mica mines of the world from which raw mica (mica not cut to any specified sizes, but just trimmed up to remove adhering rock, cracks, cross-grained parts, &c.) is shipped to London or elsewhere for sale in this mixed form, I have prepared the graph given herewith so that miners entering the mica fields for the first time, or people in new mica fields seeking information as to the proper dressing of raw mica, may know the standards required by the consumer and the merchant. It will also show the capitalist entering the field as a merchant for the first time, what actually is to be expected from any one and every case purporting to be some specific size. Further, it will give a ready means of judging the various rectangles that can possibly be got out of any one size. For the settlement of disputes, the publication of this graph will simplify the work of the arbiter, who no longer need be a so-called mica expert, as if a dispute arises regarding grading or sizing of such mica, any arbiter can be appointed by the London Arbitration Court or the London Chamber of Commerce, and such a person will be enabled to judge discrepancies as well as any mica man, provided he studies the method of reading the graph as explained below.

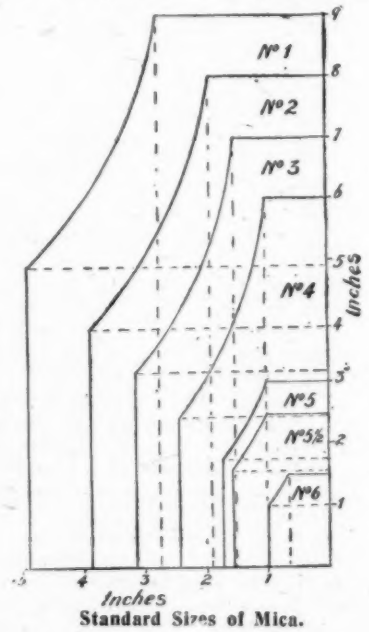
As the grades or sizes larger than No. 1 (A1, Special, Extra Special, and Extra Extra Special) are now more usually stocked and re-sorted to specified rectangles, and as these sizes are rarely offered to consumers under this standard, I have omitted them from the graph; but anyone interested in the sizes can easily extend the graph to include them, so long as he takes the average longest rectangle and the nearest square usually packed in these sizes and joins them up by a suitable curve, as has been done in the case of the sizes included in this graph. As a guide, I have given the superficial area or the dimensions, in square inches, of each of the four larger sizes as well.

To follow the graph the reader should read between the size considered and the next higher or larger size. Let us take a specific case, say a No. 4 size, 6 sq. inches to just below 10 sq. inches, which latter area represents the smallest permissible size of the next higher or larger grade, known as No. 3. A piece of raw or irregularly trimmed mica of a longish shape should cover the outline of 6 in. × 1 in., and would then represent the average shortest narrow strip that should be put in a case purporting to contain No. 4 mica; while, in the same way, of the squarish shape, the mica should cover the outline of 2 15/32 in. × 2 15/32 in., and would represent the smallest permissible square piece in a case of No. 4 mica. But we have still to consider the larger strips and squares almost up to the next larger size, No. 3, which, in the same way, for the longest strips, average 7 in. × 1 7/16 in., and for squarish pieces should cover 3 3/16 in. × 3 3/16 in., the nearest square. Any pieces, even a fraction of an inch too small to cover the various rectangles of these extreme outlines, including rectangles on curve, are considered No. 4 and not No. 3.

Turning to the graph and referring to the lines mentioned above, we see that we have in the longish strips all the space from 6 in. × 1 in. to a fraction just below the longest strip of No. 3, and in the squarish pieces we have all the space from 2 15/32 in. × 2 15/32 in. to a fraction just short of the squarish piece of No. 3. As we are now checking a No. 4 size, we take the smallest permissible rectangle contained between the 6 in. × 1 in. and the 2 15/32 in. × 2 15/32 and the graded curve.

If a piece of mica is placed on a rectangle of the graph one has to be careful first to see that all cracks, cross-grains, and rock-punctures (rock-punctures are often mistaken for spots; they are easily tested by a pin or if examined under a magnifying glass they show a hole often with a star-like crack radiating from it) are excluded from the part that is to be placed over the various rectangles of the size required in the graph—see the case of No. 4.

The rectangles themselves are represented by imaginary or pencilled-in longitudinal and lateral lines touching the curve joining the corners of the 6 in. × 1 in. and the 2 15/32 in. × 2 15/32 in. outlines. If only pieces of mica that just covered such areas were packed in a case by themselves it would be reckoned a full size No. 4, but as all the larger pieces of mica that just won't fit the No. 3 gauge or outlines of the graph (tested in the same way as the No. 4) have to be considered, and if these have been excluded from the No. 4 case above, such a case of mica, for the guidance of the buyer, should be designated small, full-sized No. 4 mica. When, however, all the available pieces too small to fit a No. 3, as above, are mixed and packed with the small full-size No. 4, which is the predominant practice, then the mica can be called, by the current trade designation, a full-sized No. 4 without the epithet "small," which is also a trade designation for the previously described full-sized No. 4 grade. It should, in fairness to both buyer and seller, be made quite clear that the percentage of the larger pieces, rejected as too small to be a full-size small No. 3, is always problematical, as it is governed by the *pro rata* of production of the sizes concerned.



Standard Sizes of Mica.

I should like to reiterate that the greatest care is necessary when gauging mica. The part covering any

* The second article in this series appeared in the ELECTRICAL REVIEW of March 14th and 21st, 1924.

specified rectangle of a size should be flawless, as explained above.

All the other sizes of mica are tested in the same way as the No. 4 size just described. If these facts are borne in mind by sellers and buyers, few differences can arise as to sizing, but the standardisation of the quality still has to be considered. I have already given an idea of this, from the ultimate consumer's point of view, so far as slab or block mica is concerned, in my second article on "Mica and Micanite Insulation" in the columns of this journal. As the ultimate consumers are the ones who are to be studied, it rests with them to take what steps they may consider necessary to standardise the qualities as well as the sizes. Combined action is all that is necessary to achieve an end so hopelessly and yet ardently sought before.

If proper specifications were made out as is done for other materials, and the same systematic methods were adopted, the British electrical industry would benefit more than fourfold. Try it! is my advice.

Here is a pre-war specification, in detail, with packing instructions left out (as they vary), for a clear, tightly laminated, rigid, free-splitting mica. The final yield fills the bill :—

SPECIFICATION.

The quality of the material and the methods of dressing shall be such as to insure for the mica the properties herein specified.

Description.—The material desired is No. 5 clear India mica 3 sq. inches to just below 6 sq. inches.

General.—The mica shall be in the form of irregular knife trimmed blocks.

Size.—The blocks shall not be less than three square inches (20 sq. cm.) in area. They shall not be less than one-hundredth of an inch (.25 m/m.) in thickness. Fifty per cent. of the blocks shall not be more than one-sixty-fourth ($\frac{1}{64}$ in.) of an inch in thickness (.4 m/m.).

Quality.—The blocks shall be sound, with clean cut edges, and not shattered and opened up. They shall be as free as possible from such defects as splits, knife cuts, air-bubbles, buckled, creased, or wavy laminæ, and rock-punctures. A one-pound sample of block taken from any case of a shipment shall produce not less than thirty-two per cent. (32%) perfect sheet, which is free from splits (or is tightly laminated), and the other above-mentioned defects, except air bubbles less than one-quarter of an inch (6 m/m.) in diameter when split into sheet under the following conditions:—The block shall be split into sheet between five and six thousandths of an inch in thickness (.13 m/m. to .15 m/m.). All pieces less than five thousandths of an inch (.13 m/m.) in thickness shall be discarded. The remaining sheet shall be trimmed to remove the defective parts. The amount of perfect sheet (tightly laminated sheet) thus obtained shall not be less than thirty-two per cent. (32%) of the original sample. [Packing and forwarding, &c., instructions should here follow.]

Splittings.

As some three thousand tons of splittings are used annually by the electrical industry, it may be as well to give an idea of the qualities standardised.

(1) In quality, the designation "extra special" implies that the splittings are pan packed in disks and are of a very fine and uniformly thin split quality; regular in outline of plates used; of a full size (with a fairly large percentage of the rejects from the size larger than itself which are packed and sold with the smaller size). The pan pack signifies that a minimum of 50 per cent. good slab has been used for splitting as, if less were used, when the splittings were being pressed in the pan, they would not hold together as they do; but this defect is also apparent when thin and thick splittings are mixed and pressed up. It is customary to allow a margin of 5 per cent. for irregularities from the above specification (and for all splittings).

(2) The designation "special splittings" implies that splittings are pan packed in disks and are of a fine and fairly uniformly thin split quality; fairly regular in outline, and a full size, but on the small side, of the size from which the spliting is made.

(3) The designation so often used, termed just "pan packed," conveys no real meaning. It may contain (1) or (2) or both, with something inferior (water pressed) in quality or even in size. This is usually a mixed quality, allowing the seller too much latitude. My advice is that all such offers should be, if accepted, subject to very careful and close inspection before final commitment.

(4) The designation "good average, full size, loose packed" implies a good quality of loose splittings (not packed in disks and pressed) that may be 1 or 2 or both mixed, but as the name suggests they consist of the best splittings that fall away from the pans in passing and packing. Sometimes these splittings are made from the cleaner films of full size taken off in cleaning mica when classifying for quality. The reason for packing these splittings loose is given in (1).

(5) The term "loose splittings" generally covers a wide rang of qualities, which in the smaller sizes are made from the pickings from the waste dumps at the mines and factories, and are usually split by the fingers, which makes most of these qualities irregular in thickness and in size and general outline.

Mica splittings have hitherto been an Indian monopoly, but there is no earthly reason why the native children of Rhodesia, South Africa, Tanganyika, Brazil and Argentina should not be trained to split mica as well and as quickly as the Indians were taught. I have taught children who have just left school here how to split, and they learnt very quickly. If my suggestion were acted on and the different native children taught, it would give the electrical industry a wider range and finer selection to choose from, while the competition would maintain a superior quality at a more reasonable price. Further, if these goods were offered through a central clearing house in London, it would materially help in standardising quality and size, and would considerably reduce the initial costs, not only of the raw splittings, but also of the goods made therefrom.

Testing Mica.

From the above it may be gathered that a closer and more careful study of mica is of vital importance to the electrical industry, using as it does over eighty-five per cent. of the mica produced by the whole world. Further, it may not be too much to suggest that problems of future improvement, even economy, and greater reliability of apparatus, containing mica and micanite insulation, can best be solved by a finer and more careful selection of these materials.

The points on which information is essential are :—

(1) Water content in mineralogical composition to see if there is sufficient to keep the mica from being brittle (brittle micas, like some ambers, particularly some clear brown qualities, break on testing for rigidity and are, moreover, easily affected even at moderate temperatures —see test given below). A peculiarity about geochemically dehydrated micas is that they are usually hygroscopic and readily absorb moisture. (See the above light brown phlogopite or amber mica.) In the absence of chemical tests this is best tested by hand, as explained under the headings of rigidity and resilience in my second article on the same subject. Tightly laminated mica that will not break or crack on testing for rigidity and resilience as a general rule may be taken to possess the right quantity of water to keep the mica resilient, and yet not make it hygroscopic. It is usually the evaporation of the water from between the laminæ of loosely laminated mica that makes it hygroscopic; the dehydrated micas are known as "dry and thirsty" mica, which term conveys its own meaning.

(2) *Iron Test.*—This is a chemical test. Up to 7 per cent. iron in the mineralogical composition of mica is not considered deleterious to the dielectric properties of mica, even though a 2 per cent. inter-lamina charge is injurious.

(3) *Thermal Properties.*—This is a technical test, and should be conducted both in an oven and also by using the mica as a support for nickel-chrome wire which is charged to the maximum voltage used for the purpose for which it is required. It should be borne in mind that a heater element, when the wire is wound round the mica, attacks the mica from two sides, and therefore finds any fault in it sooner than if attacked only from one and possibly the sounder side.

(4) *Dielectric Test.*—This is so well known to all insulation engineers that it would be useless to repeat it here.

The theoretical content of water of the muscovites is 2 to 3 per cent., and iron 4.5 per cent.; the other items of its composition are of no value to the electrical industry, and will therefore not be mentioned here. The theoretical content of water of the phlogopites (amber) is 0.38 per cent. and iron 4.83 per cent., but in practice the quantities of either element are rarely found to conform to the theoretical limits; they vary very considerably with colour, and with tight and loose laminations of the mica, *e.g.*, a loosely laminated muscovite, with its interlaminar water inclusion, showed 15 per cent. water, while a tightly laminated sheet of mica from below water level of the same mine showed only 4 per cent. water. Similarly in a phlogopite, of a loosely laminated variety, the water was 7 per cent., while in a tightly laminated variety, of the same quality, it was only 0.5 per cent., and the mica was brittle. The dehydration is a geo-chemical process that takes place in the bowels of the earth during the formation of the mica deposit. Curiously enough, these dehydrated phlogopites, or clear brown ambers, so much used, are brittle, and are less capable of standing high temperatures than those much-condemned darker varieties, which are perfectly clear in thin sheets, and are free splitting, resilient, tightly laminated, and hence contain the necessary quantity of water in their composition to make them suitable for the insulation of high-pressure apparatus or as heat-resisters. Had these facts been known to the electrical industry some years back, a large firm of manufacturing electrical engineers making a once famous radiator would not have had to close down that department in utter disgust. Like some so-called hazy ambers, the so-called white mica is generally loosely laminated and full of microscopic inclusions and air bubbles. When such mica lies flat, it reflects light in a peculiar manner that gives it a silvery white glitter, but if taken up and held to the light, the stains of these defects can usually be seen. If the inclusions are organic, they may prove deleterious to electrical work, and further, like all loosely laminated micas, are likely to absorb moisture from the air and any oil they may come in contact with.

As an experiment, a loosely laminated mica was sealed on three sides (one side being left open to allow heat to penetrate) with a tested heat-resisting varnish. After the test (mica used as a carrier of nickel-chrome wire), it was found that the three sealed edges were hardly affected, but the whole of the unsealed part was calcined, and became so friable that it fell away in flaky powder on being touched.

To give a better idea to my readers, I give a specific case of heat test of a tightly laminated rigid in thick sheets, but resilient in thin sheets, free-splitting, superior dark in thick sheets but diaphanous in thin sheets, phlogopite of a greenish tinge. The colouring was due to chlorine:—

(1) The water test was made by hand and found to be satisfactory.

(2) The quantity of iron was determined by means of permanganate of potash, after fusion of the product with alkaline carbonates, treatment by hydrochloric acid and dry evaporation.

Result iron (sesquioxide F. 2.03) 5.80 per cent.

(Muscovites are not affected by hydrochloric or sulphuric acids, but hydrofluric acid affects the loosely laminated muscovites and the surface films or laminations of tightly laminated muscovites. If loosely laminated muscovite is heated in the presence of alkaline carbonates and treated with hydrofluric acid, it is decomposed.)

(3) The heat-resistance test:—

Pieces of thicknesses of 10-12 mils and 1-2 mm. were put in a gas oven with heat *recupérateur* during two consecutive hours, for each of the three following tests. (The oven was heated progressively and the temperature ascertained by a Féry "pyromètre optique." The pieces tested were examined after cooling outside the oven.)

Test (1) heating up to 700 deg. C. The pieces showed no appreciable alteration, and the transparency, which is only apparent in the thin sheets, was maintained. Mica split as freely after heating as before heating.

Test (2) heating up to 900 deg. C. The pieces became rather brittle, owing to partial loss of water in its mineralogical composition, or we might say owing to factitious dehydration; the colour turned from a dark blacky-green to a reddish brown, making the sheets look like the so-called clear brown amber of the trades; the sheets showed, when thin, no perceptible modification in transparency except for the above discoloration. The mica did not split quite so freely after heating as before heating.

Test (3) heating up to 1,100 deg. C. The pieces became very brittle, disintegrating when handled, and the transparency was very much reduced. The dielectric strength showed 2,000 volts per mil of thickness.

The mica was also tested for softness or texture, and found to be equal in softness to the copper used in commutator segments.

This mica was further tested to see how it compared with Brazilian and Indian loosely laminated muscovite (ruby), as it was to be tried as a heater element or for carrying the wire of heating and cooking apparatus. The process and results were as follows:—

The test was made under 110 volts and 2 amps. The wire had been overheated to get a breakage in the wire so as to get a little arc.

The mica was used to support the wire of nickel-chrome. This wire was free from iron, and was composed of 80 per cent. nickel and 20 per cent. chrome.

Both the muscovite (ruby) samples broke down at 500 deg. C., and the wire broke, giving an arc, with a temperature of between 1,100 deg. and 1,200 deg. C. The blacky-green phlogopite sample was unaffected beyond becoming slightly brittle and showing a brown colour.

It is strange that only in this country do many consumers condemn a tested, proved and recommended mica just because it is not the same colour as the mica they have been used to. In my own experience I have found consumers condemn an actually superior mica, in fact one pre-eminently suited to their particular requirement, and they have accepted an inferior mica, quite unsuited to their requirement, just because the look of the latter took their fancy more than the other. This method of judging will not benefit the manufacturer who indulges in it.

Possible Economies.

By the foregoing simple tests and a finer selection of rigid, in plates, and resilient, in films, mica, a superior quality (consequently needing a smaller quantity) can be used to great advantage. The superior tested quality will also have the requisite mechanical strength, and these properties will be retained at all temperatures met with in electrical apparatus. While, from my long mining experience, it is not exaggerating to say that the supply of such qualities of mica, more met with below water level and in the deeper mines, is not only likely to continue but to increase, should mining be continued in the deeper mines, the comparative prices, owing to the lesser quantities used for the same work, will in most cases be less than at present.

Let us take a case of a turbo-generator using £450 worth of mica and micanite insulation under prevailing conditions. Under the new conditions that I lay down, the cost of the insulation will not only be reduced to £300 or £350, but the general or total cost of the machine, owing to better and less insulation, will also be considerably reduced, and this new type machine will be more reliable than those made to-day.

Mica and micanite receive so little attention, even though they are the life of the machines using them, just because it is generally understood that the sterling value of the mica and micanite used in a machine is represented by 1 per cent. to 2 per cent. of the total value of the machine. How small a part of the human structure is the heart!—remove it or let it get diseased, and see what happens to the huge body encasing it. It is up to each manufacturing electrical engineer to calculate what he can save in design by a finer selection of mica and micanite.

Flight tells us: "If the cost of manufacture is not to be increased, the space available for the iron and copper decreases as the quantity of insulation employed is increased." But as I have pointed out above, there is no need to increase the quantity of the insulation where mica and micanite are concerned; if a finer selection is made and a superior quality is used in lesser quantity, this will reduce the consumption of iron, copper, and insulation, and give a cheaper and more reliable machine.

A tightly laminated, rigid (in thick sheets), but resilient (in thin sheets or films) free-splitting mica, whether muscovite or phlogopite, is best suited for heater elements and wherever a high temperature is likely to be met with in electrical apparatus. Carefully sealed, with a heat-resisting varnish, loosely laminated mica also answers for some of the above purposes, particularly when the temperature is not too high. For condenser plates, only a natural tightly laminated muscovite should be used.

A fairly rigid, soft on cut edge (soft texture) resilient free-splitting mica, whether muscovite or phlogopite, is best suited for commutator work of small dimensions. I have already dealt with commutator micanite used for commutator segments of large dimensions. Any mica offered for commutator segments should possess the following essential properties:—

(1) The mica should be rigid, resilient, and of soft texture.

(2) It should resist the highest temperature likely to be met, or it should be uninfluenced by heat up to several hundred degrees Centigrade.

(3) It should be of uniform thickness, a property only possessed by free and uniformly splitting mica.

(4) It should not absorb moisture or oil.

(5) It should be a good and reliable insulator.

The poorer qualities of mica, the spotted, &c., are suitable for low-voltage work, for washers, terminal insulation, banding purposes, discs, &c.

These particulars are only given as a rough and ready general guide, and are taken from some of my personal records, but tests are necessary in each and every case where any doubt exists in the minds of the insulation engineers responsible for the work of selecting and passing mica and micanite for specific uses. If such tests were regularly carried out by a central depôt responsible for the whole industry, and the sellers were notified of the results of the tests, more care would be exercised so that automatically there would arise a finer selection which would be to the advantage of the whole of the electrical industry. In a nutshell, this means: better construction, greater reliability and greater economy, with a decided reduction of costs of manufacture which will enable the British electrical industry to hold its own against any other competing country on all points.

I have casually heard that one or two of the larger electrical firms contemplate owning and operating mica mines. If they propose owning and operating both muscovite and phlogopite mines I say go ahead; otherwise, as so many classes of mica of both these groups are used by large manufacturers for the different purposes I should think that a Central Clearing House responsible to the British electrical industry would be more feasible and economical. Miners would readily sell through such a medium, and knowing their market, would dress and treat the mica, micanite, and other mica goods of the ground work type exactly as laid down in the specifications submitted to all the miners by the C.C.H. of the electrical industry, while the electrical industry would not only get exactly what they want at the shortest notice, owing to stocks of standardised material being in London at the disposal of the C.C.H., but they would find that the better, more reliable material would, after they had taken all expenses into account, cost them about 25 per cent. less. I am writing from my own personal experience in mica mining, dressing and manufacture which covers over 19 years in this special field, and embodies in the manufacture the very best practice of the Continent, the United States of America, and the United Kingdom.

In my next article I shall deal with the manufacture of brown moulding micanite, flexible micanite, mica cloth, silk, paper, folium, tubes, washers, vee rings, &c.

The Control of Electric Furnace Current.

By "LAPIS LAZULI."

THE control of electric current required in the manipulation of electric furnaces is a much larger subject than most readers are led to believe, judging from the accounts given by many text-books on electro-metallurgy. In some instances this work is almost ridiculously under-rated, whereas in other cases it is not even mentioned.

Where arc furnaces are employed, the control requires greater care than where induction or resistance furnaces are manipulated. Those acquainted with modern developments of the subject will appreciate the use of automatic regulators, several of which are now on the market. Like most other novelties, however, such regulators are being burdened with a serious drawback. Although they represent a high standard of scientific construction and efficient workmanship, the finished article is of much too delicate a character to be extensively employed in ordinary works practice. At the present time, hand methods of manipulating electrodes are most generally preferred.

Different Melting Stages.

The melting of scrap is one of the features which characterise all modern furnaces, and as scrap is usually secured in a mixed heterogeneous mass, the insertion of electrodes at the commencement of the melting period requires to be conducted with caution. The arc does not require to be struck, since the current is of such high amperage that the arc is formed before the carbon has reached the metal. Should the former inadvertently touch the metal, it is liable to break the connection and require renewing by restarting at the oil switch.

Great fluctuations are experienced with the current entering the furnace at this period, and the control of the gear wheels is no simple matter. As the jagged edges are rounded off with the increasing heat, the flattened surface of the scrap charge permits more liberties to be taken. Thrusting in the metal with rabbles is a frequent source of trouble, as pieces of solid metal are forced on to the "carbons."

When all the metal has been melted and fluxes are being added, the control of the current is greatly simplified, sometimes being entirely left in the hands of one man, even with large furnaces. The smooth layer of slag does not offer any resistance to the insertion of the electrodes, so that the temperature at this point can be rapidly raised to a very high degree. The voltage em-

ployed in steel melting is usually lowered towards the conclusion of the process, but the amperage is almost doubled. This causes a distinctly deoxidising atmosphere to pervade the enclosed hearth, and reduces any oxidisable matter in a very short period. It is of particular value in the "desulphurising" process, as the lime and graphite are thereby formed into calcium carbide, which reduces the sulphur very effectively.

At this period the carbon content of the steel is altered to the required figure, and any careless handling of the electrodes would tend to produce unexpected changes in the percentage composition. The amperage employed has a direct bearing on the proportion of carbon absorbed from the carbide slag, and any breakdown at the power station, or trouble with the transformers at this point would seriously influence the composition and structure of the metal.

Some Effects of the Current.

Various measures are used to control the effect produced by currents of different amperage and voltage. The amount of oxidation or deoxidation formed is examined by watching the "pipe" formed in a small ingot of freshly poured metal. A sample is lifted in an iron spoon from underneath the slag, poured into an iron pot mould, and the general appearance and amount of "sink" noted.

A slightly increased voltage and considerably reduced amperage favours oxidation, and at this stage in steel melting, phosphorus, carbon, and silicon, together with numerous less important impurities are oxidised. The oxides, being light in weight, rise to the surface and are absorbed in the rich lime slag.

Experienced melters closely observe the mechanical effect that the current produces at the arcs, *i.e.*, the swirling motion imparted to the molten mass. The pace at which the metal is moving is largely responsible for the amount of elements which can be removed from it, or the additions made to it. This subject is much too comprehensive to be dealt with lightly. It might be mentioned, however, that the current in many instances is so manipulated as to meet the requirements which this phenomena necessitates.

As regards danger to the operatives engaged, this is not so likely to be experienced from shock as from burns, the current being of comparatively low voltage (although high amperage). For the ordinary electric furnace of small tonnage, the voltage employed seldom exceeds 100, but the amperage may be 5,000. Burns caused by the careless handling of bus-bars, and similar exposed parts, are usually of a serious nature. Except on very rare occasions, severe burns are almost entirely due to ignorance on the part of the labourers. This, of course, does not refer to accidents experienced when treating the molten metal.

When repairs require to be undertaken at the electric furnace, the assistance of electricians possessing no previous acquaintance of the hearths is of very little value. A thorough understanding of the principles of the process worked is absolutely essential to any repairers who are likely to be consulted on the construction or any suggested improvements, otherwise advice given from their own standpoint (as "jobbing electricians") is of little account. Temperature is as much a governing factor as electric current, and the one must be fully appreciated to realise the effects and reactions of the other.

Setting up cabling, insulators, &c., are small jobs when compared with the accompanying brickwork and masonry connected with hearth construction, and the materials employed in this work must be viewed from their electrochemical, metallurgical, and mechanical properties.

Business Notes.

Bankruptcy Proceedings.—M. C. JONES & Co. (a limited partnership), 239, Westgate Road, and 65, Thornton Street, both Newcastle-on-Tyne, stockists of wireless parts and accessories.—The receiving order in this matter was made on March 27th on debtors' petition. The statement of affairs shows liabilities of £2,156, against assets of £1,172. The first meeting of the creditors was held on April 14th at the County Court, Westgate Road, Newcastle-on-Tyne. The following are creditors:—

	£		£
Allen Liversedge, Ltd.	25	Langham Electric Supplies Co.	128
Ashley Wireless Telephone Co.	45	M. E. L., Ltd.	18
Birmingham Products, Ltd. ...	159	Metropolitan-Vickers Electrical Co., Ltd.	370
Burndept, Ltd.	77	A. S. McHugh & Co.	23
Cables & Electrical Supplies ...	34	Northern Steel & Hardware Co., Ltd.	15
Canadian Brandes, Ltd.	39	Chas. O. Pattison	17
Ebonestos Insulators, Ltd. ...	25	Radio Communication Co. ...	61
Edison Swan Electric Co., Ltd.	180	Radio Instruments, Ltd.	73
Empire Radio Co.	32	Siemens Bros. & Co., Ltd. ...	44
Fuller's United Electric Works	193	Sterling Telephone Co., Ltd. ...	52
General Electric Co., Ltd. ...	41	Telephone Manufacturing Co. ...	48
Gilbert Engineering Co.	30	Victoria Electrical (Manchester), Ltd.	46
Greengate & Irwell Rubber Co.	43	Wright & Weavie	37
Ivorine Label Co.	18		
Sydney Jones & Co. (London), Ltd.	37		
Hy. Joseph & Co., Ltd.	56		

Trustee, Mr. W. Brittain, Pearl Buildings, 4, Northumberland Street, Newcastle-on-Tyne, appointed April 19th.

H. P. TUCKER, electrician, Empire Bungalow, Ellacombe, Torquay.—Receiving order made April 15th, on creditor's petition. First meeting, May 2nd, at the Official Receiver's office, 67, High Street, Exeter; public examination, May 23rd, at the Castle, Exeter.

D. E. JONES (D. E. Jones & Co.), electrical contractor, 29, Carne Street, Pentre, Glam.—Receiving order made April 16th, on debtor's own petition.

Company Liquidations.—COX-CAVENDISH ELECTRICAL CO., LTD., Great Portland Street, London, W., and Acton Lane, London, N.W., manufacturers of electromedical apparatus, and wireless goods and electrical appliances.—A meeting of the creditors of the above was held on April 24th, at Donnington House, Norfolk Street, Strand, W.C. The chair was occupied by Mr. R. J. Blackadder, of Messrs. Howard, Howes & Co., C.A., Norfolk House, Norfolk Street, who had been appointed to act as the receiver for the debenture holders, and as the liquidator in the voluntary liquidation of the company.

The statement of affairs submitted showed gross liabilities of £46,698, of which £23,341 was expected to rank. The assets were estimated at £45,094, from which had to be deducted £1,802 for preferential claims, and £21,555 due on debentures. The net assets, therefore, were £21,738, or a deficiency of £1,603, so far as the unsecured creditors were concerned. The assets consisted of: Cash in hand, £57; book-debts, £4,880, expected to produce £2,900; loans to employés, £749, estimated to realise £304; stock, £20,897, valued at £14,627; freehold land and buildings (book value), £16,299; plant, machinery and tools (book value), £6,910; and furniture, fixtures, fittings, electros and wood-cuts (book value), £3,997. The issued capital of the company was £40,391, and as regarded the shareholders there was a deficiency of £41,994.

The Chairman stated that the company was formed in 1911, with a nominal capital of £5,000, which was increased in 1918 to £25,000. In 1919 an amalgamation with another business took place, and the capital was then increased to £60,000. In 1919 there was a boom in trade, and the company had a great many orders. As a result it was decided, in order to cope with the work, to increase the factory and add to the machinery and plant. During 1919 and 1920 the company spent between £8,000 and £9,000 on the factory. That expenditure was financed by means of a debenture issue which took place towards the end of 1920, when debentures for £15,000 were issued. Unfortunately, just when the factory was completed and ready to cope with the increased trade, a slump set in. That slump caused a heavy loss owing to the depreciation of the stock. The audited accounts to March 31st, 1920, disclosed a loss of £1,739, but in the following twelve months there was a profit of £125. The accounts for the year to March, 1922, owing to the writing down of stocks and the company's feeling the full effect of the trade slump, disclosed a loss of no less than £11,159. That loss, although due to some extent to the writing down of stocks, was also contributed to by the very heavy financial charges and the difficulties of trading with shortness of capital. In 1922, the question of taking up wireless work in addition to the X-ray and electro-medical branch was considered by the directors. They realised that the X-ray and the electro-medical work was insufficient to keep the large factory fully employed. An arrangement was entered into with a selling organisation called the General Radio Co., Ltd., under which the Cox-Cavendish Electrical Co. agreed to sell the whole of its output to the other concern. The General Radio Co., Ltd.,

also undertook to put all its business through the Cox-Cavendish Co., whilst the latter was also to receive a percentage of the profits made by the former. A large number of orders was received by the Cox-Cavendish Co. and the prospect appeared to be bright. The directors believed that they had turned the corner, but there were difficulties in manufacture and in the supply of raw material. The result of those difficulties was that the accounts for the period to June, 1923, disclosed a loss of £5,592. That loss was arrived at after capitalising certain items of development expenses amounting to about £6,000. The real loss for the period was something like £11,000 or £12,000. The position was sufficiently serious at that time for the debenture holders to have appointed a receiver. The directors, however, hoped for the best and the debenture holders did not exercise their rights to appoint a receiver. It was believed that the outlook was sufficiently bright to allow the company a further run. Subsequently further difficulties arose—partly financial—with the result that the trading from June, 1923, down to February 26th last, when the receiver was appointed, showed a further loss of rather more than £8,000. That figure was arrived at before charging depreciation. In February of the present year the position was very acute and the directors saw that there was no prospect of carrying on the company. The bank overdraft was practically up to the limit, and the debenture holders decided to take action. Under the debentures the holders were entitled to appoint a receiver when the debit on the profit and loss account stood at £1,000. In February the debit was in the neighbourhood of £26,000. With regard to the assets, the loans to employés had been written down as certain servants might have claims against the company. The value of the stock was problematical; some of it was old and might not realise anything like the cost price. If the business could be disposed of as a going concern a better price would be realised than if it had to be closed down. At the moment he (the chairman) was carrying on the business, and all the output went to the General Radio Co. at prices which were profitable although he did not say that there was very much in it. There were contracts in hand to the extent of £27,000. He would have to consider whether those contracts would be carried out, as to complete them would mean finding finance to the extent of £9,000. The X-ray and electro-medical stock was being sold at satisfactory prices. The main part of the business was the manufacture of wireless appliances, and so far no offer had been received for that department. The directors had considered the matter, and had drawn up a scheme, but so far they had not been able to get anyone to buy the business. It was difficult to say how the present position had been brought about, but he thought there had been a somewhat undue spirit of optimism displayed. It might have been better to have faced the position when the big losses occurred in 1921 and 1922. Many items had been capitalised which might just as well have been added to the profit and loss accounts. No dividends had been paid for years. The directors, who had received no fees since 1920, had guaranteed the bank overdraft up to £5,000. The salaries drawn by the working directors were quite moderate. The bank overdraft at the moment stood at £5,300, and was included in the ranking liabilities.

The representative of Messrs. Watson & Sons (Electro-Medical), Ltd., pointed out that the company had incurred losses totalling £28,000 since 1920, whilst during the last eight months the deficiency so far as the shareholders were concerned had been increased by £8,000. He thought that the creditors should have been consulted at a much earlier date. He also suggested that the creditors should be represented in the liquidation.

In answer to questions the chairman stated that the debentures carried interest at the rate of 10 per cent. per annum.

Mr. C. Wells, of the Wholesale Traders' Association, remarked that the rate of interest was heavy.

The Chairman: Looking at the balance sheets I would not put in any money.

A creditor remarked that manufacturers ought not to have been allowed to deliver goods to the company during recent months. He himself had never received a penny piece from the company, and yet his firm was allowed to keep on delivering goods.

Another creditor: I am in the same position.

Replying to further questions, the chairman stated that the company had received money, representing a share of the profits, from the General Radio Co. The directors of the Cox-Cavendish Co. were of the opinion that they were making a big profit on the sales to the General Radio Co., but the accounts showed that that could not be correct. As far as he understood the matter the General Radio Co. was formed to buy the output of the Cox-Cavendish Co. The General Radio Co. appeared to have paid in advance for goods, as the Cox-Cavendish Co. was in a bad way. The General Radio Co. was actually a creditor for between £800 and £900. The figures as to the costings showed that the Cox-Cavendish Co. was making fat profits on its sales to the General Radio Co., and the directors of the former were astonished when the results of the last eight months' trading were ascertained. All the debentures were issued for cash.

Mr. H. Hackett declared that the matter was one which called for investigation. There was a boom in the wireless trade and the company ought to have been able to trade profitably.

In answer to a creditor it was stated by the chairman that he thought he was meeting expenses, and he hoped to sell the business as a going concern.

After a lengthy discussion a resolution was unanimously passed in favour of Mr. A. Nisbet, C.A., being appointed to act as joint liquidator with the chairman, while a committee was also nominated consisting of the representatives of Messrs. McLoud & McLoud; Swift, Levick & Sons; L.P.S. Electrical Co.; West Central Engineering Co.; and the London Electric Wire Co.

THE WHOLESALE MACHINE SUPPLY CO., LTD., 23, Osborn Street, London, E.—In pursuance of the Provisions of the Companies (Consolidation) Act, 1908, a meeting of the creditors of the above was held on April 24th at the Holborn Restaurant, W.C., when Mr. Leslie C. Stewart, I.A., of Avenue Chambers, Southampton Row, W.C., presided. A statement of affairs presented disclosed liabilities of £9,918, all of which was due to unsecured creditors. There were debentures for £979 and a fully secured creditor for 8s. 6d. who held security valued at £7 10s. The assets totalled £3,829, from which had to be deducted £78 for preferential claims, and £979 for debentures, leaving net assets of £2,771, or a deficiency of £7,147. The company was formed on November 4th, 1922, with a nominal capital of £2,000 in £1 shares, and the issued capital at the date of liquidation was £1,807. The liquidator said that a petition had been presented for the compulsory liquidation of the company and was due for hearing on April 29th next. A creditor proposed that the petition should be supported, but an amendment was carried that application should be made to the Court for the appointment of Mr. W. A. J. Osborne, of Messrs. Corfield & Cripwell, Balfour House, Finsbury Pavement, E.C., as liquidator in the place of Mr. Stewart. The following are creditors:—

	£		£
Condor Lamps (Great Britain), Ltd.	1,581	Muldive Calculating Machine Co., Ltd.	64
Holmes, Terry & Co., Ltd. ...	1,125	Wilkins & Wright, Ltd. ...	61
Dodgson White, Ltd.	492	Central Agency, Ltd.	61
Buel, G.	444	Beard & Fitch, Ltd.	60
Cleminson, M.	428	Burroughs Adding Machine, Ltd.	61
Cohen, C.	410	Wallis, H. O., & Co.	59
General Radio Co.	376	Albion Sewing Cotton Co., Ltd.	58
Falsing Products Co.	326	Ashbery Philip & Sons Ltd. ...	55
Acme Production Co., Ltd. ...	260	Central Sewing Machine Co. ...	54
Fellows Magneto Co., Ltd. ...	243	Aku Co.	50
Crystalate Manufacturing Co., Ltd.	242	Rothermel, R. A., Ltd.	49
Coomes, J. A., & Co., Ltd. ...	232	Peerless Light Co., Ltd. ...	49
"Hamco"—Nijmegen, Nijmegen (Holland) Johannas Vijghstraat	204	Rodgers, J., & Sons, Ltd. ...	46
Stenards, Ltd.	159	Nugget Polish Co., Ltd. ...	45
Globe-Wernicke Co., Ltd. ...	139	Scott Insulated Wire Co., Ltd.	46
Macintosh Cable Co., Ltd. ...	139	Master Radio Manufacturing Co.	43
B.K.B. Electric Motors, Ltd. ...	130	Brook, E., Ltd.	43
Paragon Rubber Manufacturing Co., Ltd.	105	Stewart, Leslie C.	42
British L.M. Ericsson Manfg. Co., Ltd.	104	Fagan, W. H., & Son	37
Gesteiner, D., Ltd.	102	Northern Radio Co.	36
Power Equipment Co., Ltd. ...	103	Ryalls, Turner & Co., Ltd. ...	37
Addressograph, Ltd.	100	Cake, Arthur, & Co., Ltd. ...	37
Mosley, R. F., & Co., Ltd. ...	97	Beldam Tyre Co. (1920), Ltd. ...	33
Underwood Typewriter Co., Ltd.	93	Kent Bros.	33
Visible Writing Machine Co., Ltd.	91	Marechal, Ltd.	31
Jordan, L.	90	Glossit Co.	29
Cossor, A. C., Ltd.	86	Sowerby, C. H.	29
Hughes & Co.	83	Birmingham Products, Ltd. ...	28
Lilley & Skinner, Ltd.	80	Weinthrop, J.	27
Burndept, Ltd.	69	Jones Sewing Machine Co., Ltd.	26
		Hawkins, Thos. F., & Son, Ltd.	24
		Palmerley, John	23
		Avon India Rubber Co., Ltd....	22
		Read, C. & F., & Co., Ltd. ...	21
		Englebert Tyres, Ltd.	21

NEW ELECTRA SIGN CO., LTD.—Winding up voluntarily. Liquidator, Mr. E. H. Hawkins, 4, Charterhouse Square, E.C., in place of Mr. R. Barlow Tyler, who has resigned. Meeting of creditors, May 5th, at the Liquidator's offices. Particulars of claims by May 17th.

Private Arrangement.—E. GRIFFIN, trading as Ernest Griffin & Co., 80, Newington Causeway, London, S.E., machine tool and small tool, iron, steel, and machinery merchant, &c.—A meeting of the creditors herein was held on April 24th, at the offices of Messrs. Hibberd, Bull & Co., C.A., 6a, Devonshire Square, E.C., when a statement of affairs was presented which disclosed liabilities of £3,601, of which £1,904 was due to the trade, while there was a bank overdraft of £1,122, and cash creditors for £575. The net assets were £1,126, or a deficiency of £2,475.

After some discussion a resolution was passed that, subject to the execution creditors and the cash creditor foregoing their claims, the debtor be requested to execute a deed of assignment to Mr. C. H. Bull, of Messrs. Hibberd, Bull and Co., and Mr. C. Latham, of 15, Eastcheap, E.C., as trustees. The creditors include the following:—

	£		£
Chas. Churchill & Co., Ltd. ...	86	Radio Equipment Co.	29
Dubilier Condenser Co., Ltd. ...	75	Radio Instruments, Ltd.	16
Engineering Supplies, Ltd. ...	53	Sterling Telephone & Electric Co., Ltd	100
Hart Accumulator Co.	65	Siemens Bros. & Co., Ltd. ...	93
Igranic Electric Co., Ltd. ...	58		
Langham Electric Supplies Co.	117		

Deed of Assignment.—SIMPSON, ARCUS & Co., wholesale electrical suppliers, 6, Douglas Street, Glasgow.—Particulars of claims to be sent to the Trustee, Mr. J. W. Mackinnon, 145, St. Vincent Street, Glasgow, forthwith.

Catalogues and Lists.—MESSRS. L. G. HAWKINS & Co., LTD., 116, Charing Cross Road, W.C.2.—An illustrated pamphlet describing a combined lamp and "smoker's companion."

VICKERS & INTERNATIONAL COMBUSTION ENGINEERING, LTD., Africa House, Kingsway, W.C.2.—An illustrated pamphlet describing the "Lopulco" pulverised full system very fully.

THE SWEDISH GENERAL ELECTRIC, LTD., 5, Chancery Lane, W.C.2.—Stock List No. 113, containing particulars and prices of d.c. and a.c. motors, starters, &c.

SIMPLEX CONDUITS, LTD., Garrison Lane, Birmingham.—List No. 1,024, containing prices of electrical accessories, and Conduit Price Schedule No. 1027.

MESSRS. BEECROFT & PARTNERS, LTD., St. Peter's Close, Sheffield.—An illustrated folder drawing attention to the firm's analysis and testing services.

FULLER'S UNITED ELECTRIC WORKS, LTD., Woodland Works, Chadwell Heath, Essex.—An illustrated catalogue containing specifications of the company's house-lighting accumulators.

MESSRS. BASTIAN & ALLEN, 58, Haymarket, S.W.1.—A priced folder illustrating and describing "Bastian" geysers and "Quartzalite" heaters, and a leaflet also dealing with the geysers.

Book Notices.—Publications of the United States Bureau of Standards. Scientific Paper No. 477, "Spectroradiometric Analysis of Radio Signals" (10 cents); Circulars No. 56, "Standards for Electric Service" (60 cents); No. 150, "Recommended Specification for Quicklime and Hydrated Lime for use in the Manufacture of Sand-Lime Brick" (5 cents); and No. 153, "Recommended Specification for Quicklime and Hydrated Lime for the Manufacture of Silica Bricks" (5 cents). Technologic Papers No. 240, "Dynamometer Tests of Automobile Tires" (10 cents); No. 241, "A Comparison of the Deoxidation Effects of Titanium and Silicon on the Properties of Rail Steel" (10 cents); No. 243, "Stresses in a few Welded and Riveted Tanks Tested under Hydrostatic Pressure" (10 cents); No. 244, "A Measure of the Color Characteristics of White Papers" (5 cents); and No. 245, "Embrittlement of Malleable Cast Iron Resulting from Heat Treatment" (5 cents). Also two brochures on the elimination of waste in asphalt and woven-wire fencing (5 cents each). Washington: Government Printing Office.

"Jahrbuch der Elektrotechnik, 1922." Pp. 241. Munich: R. Oldenbourg. Price 10 g.m.

"*Journal* of the American Institute of Electrical Engineers." Vol. XLIII. No. 4. April, 1924. New York: The Institute. Price $1.

"*Journal* and *Transactions* of the Society of Engineers." Vol. XV. No. 1. January-March, 1924. London: The Society. Price 5*s*.

"*Journal* of the Institution of Engineers (India)." Vol. IV. April, 1924. Calcutta: The Institution. Price Rs. 50 per annum.

"Principles of Electric Motors and Control," by G. Fox. Pp. xiv+499; figs. 298. London: McGraw-Hill Publishing Co., Ltd. Price 17s. 6d.

"Annali delle Utilizzazioni delle Acque." Vol. I. 1924. Rome: Tipografia del Senato.

"Science Abstracts" (A and B). Vol. XXVII. Part 4. April 25th, 1924. London: E. & F. N. Spon, Ltd. Price 3s. each.

"Alternating Current and Induction Motors," by T. Harding Churton, M.I.E.E. (Third edition.) (Pp. 67; 29 figs.) Leeds: T. Harding Churton & Co., Ltd. Price 2s. In a small space the author of this booklet presents a great deal of information regarding alternating current, induction motors, and auxiliaries. The chapters on the rating, selection, and management of motors are of particular value.

For Sale.—Assets Auctions Co., Ltd., will offer by auction, on May 7th, at 85, Newington Causeway, S.E., electrical cable, switches, conduit fittings, motors, &c. (See our advertisement pages to-day.)

Broadcasting Opportunities in Italy.—The Federation of British Industries points out that the Italian Government, which some time ago forbade broadcasting activities, later withdrew the prohibition on condition that firms undertaking this particular commercial development should be sanctioned by the authorities. "American firms have endeavoured to capture the market, but without success, but Italians who have endeavoured to interest British manufacturers of broadcasting materials appear to have met with little encouragement. One firm alone has placed in a bank at Milan half a million lire for broadcasting purposes, and is now waiting for the Government sanction, which can only be delayed a few weeks. This sanction will be useless so far as English trade is concerned unless the English firms with whom they have been in correspondence arrive quickly at a decision, as no fewer than seven other companies which have been formed with headquarters in Milan to carry out broadcasting are relying on Germany for support. This naturally means that almost all the apparatus which will be used for years in Italy will be purchased in Germany unless some prompt action is taken by British firms."

Unemployment.—The registers of the Employment Exchanges in Great Britain recorded, on April 14th, a total of 1,039,200 unemployed persons. This was 5,046 less than the previous return, and the reduction since the beginning of the year has been 246,420.

British Empire Exhibition Notes.—PRELIMINARY NOTICES OF EXHIBITS.—We have received brief particulars of their stands from the following exhibitors:—

MESSRS. NEGRETTI & ZAMBRA, LTD., are showing industrial instruments for indicating and recording temperature, moisture, and pressure; meteorological instruments; and household instruments—barometers, &c.

THE POWER PLANT CO., LTD. (West Drayton), has a large collection of gears of all kinds, as well as working models of gear-driven machinery.

MESSRS. G. H. GLEDHILL & SONS, LTD., show cash tills, the "Shaftometer" for levelling machinery and shafting, &c.

GLEDHILL BROOK TIME RECORDERS, LTD., exhibits workmen's time-recorders, wage-paying accessories, coin-sorting apparatus, filing cabinets, &c.

MESSRS. J. H. TUCKER & CO., LTD., show tumbler switches of all kinds, including the quick make and break type, small battery-charging switchboards, ironclad switches and fuses, lampholders, and other electrical accessories.

STELLA PRODUCTS (London) is showing crystal radio receiving sets, valve amplifiers, loud speakers, telephones, and other radio accessories.

Swiss Aluminium Shareholding.—Speaking at the recent annual meeting of the Aluminium Industrie A.G. of Neuhausen, the chairman stated that the shares in the company were held as to 86 per cent. in Switzerland, 6 per cent. in France and Belgium, and 5 per cent. in Germany, these figures showing that the reproach that the undertaking was a German company was without foundation.

List of Contractors to Belgian State Railways.—The Belgian State Railway authorities at 17, Rue de Louvain, Brussels, announce that they are revising the list of manufacturers and merchants from whom tenders are invited for the supply of railway requirements. In order to prevent omissions and errors, manufacturers and merchants desirous of being included in the lists are invited to furnish without delay particulars of their products, with full details in the case of specialities. As large sections of the system are being electrified, this information may be useful to British electrical engineering firms.

Electrical Imports into India.—Returns lately to hand show that there was an increase during February last in the imports of electrical machinery into India to the extent of 1,122,657 rupees as compared with the corresponding month of 1923.

Belgian Electrical Reorganisation.—During the past year the Société d'Electricité et de Mécanique (Procédés Thomson-Houston et Carels), of Ghent, has completed the reorganisation of its electrical departments. It is also devoting special attention to the lamp-making industry and to telegraph and wireless apparatus. The orders secured during the past year showed a considerable improvement over 1922, and enabled a larger number of men to be employed.

British Trade-mark Applications.—The following are among the recent applications for British trade marks. Objections to any of the proposed marks may be lodged within one month of the dates mentioned. In the case of foreign applications the name and address of the British representatives are also given:—

Pile Wylef. No. 446,265. Class 8.—Electric batteries. Louis Lefevre, 5, Rue de Pré aux Clercs, Paris. (D. Young & Co., 11 and 12, Southampton Buildings, Chancery Lane, London, W.C.) April 23rd, 1924.

The Ventimotor. No. 446,174. Class 18.—Plant for generating electrical energy from the natural power of the wind. Ventimotors, Ltd., Friars House, New Broad Street, London, E.C.2. April 23rd, 1924.

Magniplex. No. 446,329. Class 13.—Wire gauze for use in the construction of aerials for wireless telegraphy and telephony. Helixo, Ltd., 11, Henry Buildings, Gresse Street, Rathbone Place, London, W. April 23rd, 1924.

French Aluminium Industry.—Discussing the situation of the aluminium industry in the light of the import and export statistics, a French contemporary states that the position in 1923 became reversed in the sense that France became an importing country in the matter of aluminium ingots, as the home works were unable fully to satisfy the whole of the demand. On the other hand, the exports of manufactures in the form of sheets, cables, wire, &c., showed an increase, which fact is considered to be a good sign of development as compared with the export of the crude metal. It is noted that the imports of ingots were mostly from Norway, which produced them from the raw materials obtained from France.

New Showrooms.—The Swindon Town Council has decided to erect new showrooms and stores in connection with the electricity undertaking at a cost of £5,000.

Recent Contracts.—THE SIEMENS AND ENGLISH ELECTRIC LAMP CO., LTD., has received a large order from the Admiralty for gasfilled lamps for use in dockyards.

HOLOPHANE, LTD., has recently secured the contract for the supply of 3,500 band refractors for the City of Buenos Aires. Other recent street-light installations include Bombay, The Hague, Leeds, Manchester, Edinburgh (Princes Street), Glasgow (Great Western Road), London (Charing Cross district), Blackpool, Warwick and Worksop. Another important contract now in hand is for 2,500 reflector refractor units and glassware for 12 schools under the West Ham Education Committee.

The General Post Office has placed an order for 12 table resistances with the EDISON SWAN ELECTRIC CO., LTD.

Trade Announcements.—The business of Messrs. MALCOLM AND JOYCE, electrical engineers, of Cross Roads, Farnborough, Hants., has been taken over by Mr. E. F. Joyce, son of the late Mr. F. R. C. Joyce.

EBONESTOS INSULATORS, LTD., announce the appointment of Mr. K. H. Kerr as its London representative, in place of Mr. Rudd, who has relinquished his connection with the company.

MR. J. V. BRITTAIN, B.Sc., has opened an office and warehouse at 2, Glebe Buildings, Stoke-on-Trent, where he specialises in colliery and works wholesale supplies. He desires to receive catalogues from electrical firms.

MESSRS. J. L. DAVIES & CO., electrical engineers and contractors, have re-opened their branch at Sandy Bank, Ystrad Rhondda, and they desire to receive catalogues and price lists of electric wiring accessories, fittings, motors, &c.

MESSRS. A. R. PERTWEE and K. E. JONES have opened an office as Pertwee & Jones, electrical, mechanical, &c., engineers and factors, at Boston Buildings, James Street, Cardiff. Mr. Pertwee was lately technical assistant to Mr. J. Wayne Morgan, M.I.E.E., consulting engineer, of Cardiff, and Mr. Jones is a marine engineer.

Russian Industrial Notes.—*An Electricity Supply Conference.*—The Supreme Council of National Economy has authorised the holding of an all-Russian conference on electricity supply at the beginning of June.

Reductions in Selling Prices.—In conjunction with the recent general reduction in the prices of many manufactured goods, the Technical Bureau of the State Trading Department ordered that the prices of lamps and electrical accessories should be lowered by 10 per cent. as from the beginning of April.

Electric Boring Apparatus.—As was recently mentioned, the Central Electrical Trust has supplied an electric boring set to the Baku Oil Syndicate. The results have proved to be successful, and the speed of drilling is said to be much greater than in the case of boring appliances operated by steam power. A similar set of boring plant is now to be delivered to the Grosny Oil Syndicate.

Electrical Credits.—The annual meeting of the Electro-Credit Co. was held in Moscow in the second week in April, and from the details of the report which was presented it is obvious that this financial undertaking is suffering from a lack of capital which prevents any great development of its activity. About one half of the share capital has been provided by State institutions and co-operative associations, but it has been impossible for the credit company to obtain large loans either from the State Bank, the General Co-operative Bank, or the Industrial Bank. Under these circumstances the activity of the company has been mainly devoted not to the grant of financial means for the advancement of electrical undertakings, but to the grant of credits in the form of the supply of electrical machines and materials in association with the electrical trusts and other manufacturing works. Nevertheless, the net profits for 1923 are reported at 46,000 gold roubles, and the dividend is 10 per cent. An application has now been made to the Council of Labour and Defence for permission to raise the share capital from 2,000,000 roubles to 5,000,000 roubles, and part of the additional capital is proposed to be issued in small denominations so as to increase the scope of possible shareholders, the lowest share being put at 10 roubles. On the other hand, a scheme is being promoted with a view to the conversion of the credit company into a real banking institution.

New Belgian Company.—The Private Telephone Company Installation is the English title of a new Belgian undertaking lately formed in Brussels (53, Boulevard Anspach) with a capital of one million fr.

Ireland and Continental Tenderers.—The Enniscorthy, Co. Wexford, Ireland, Urban District Council has instructed its consulting engineers, Messrs. MacEnver & O'Kelly, Dublin, to advertise as soon as possible for the necessary plant and equipment for the proposed public electricity undertaking. During the discussion it was urged by several members of the Council that it would be desirable that ample time should be given to enable Continental manufacturers to prepare and submit tenders, and the engineers were instructed accordingly.

Sydney Electrical Contracts.—A CORRECTION.—With reference to the notice appearing in our last issue under this heading, in which we quoted a report from the *Industrial Australian and Mining Standard*, stating in effect that Mr. Suttor was in the service of the British General Electric Co., Ltd., the General Electric Co., Ltd., of Magnet House, London, asks us to state that the Australian report is incorrect, as Mr. Suttor was never in the employ of the British General Electric Co., Ltd., but of the Australian General Electric Co., Ltd., which has no connection whatever with either the British General Electric Co., Ltd., or the General Electric Co., Ltd., of England.

American Electric Vehicle Exports.—Since the commencement of the present year a separate classification has been given in the monthly American export returns for electric private cars and industrial vehicles. The shipments during January last comprised three private cars and 28 trucks, of a total value of $76,348. In the first month of 1923, when the two classes were grouped together, 26 vehicles, valued at $36,213, were exported.

Lighting and Power Notes.

Bedford.—LOAN.—The Town Council is applying to the Electricity Commissioners for sanction to the borrowing of £85,000 for electricity purposes.

Bo'ness.—ELECTRICITY SUPPLY.—The Town Council has granted permission to the Scottish Central Power Co. to extend the h.p. cable from the electricity works to the southern boundary of the burgh. Ultimately the cable will be extended to Linlithgow.

Canada.—GRAND FALLS SCHEME.—Official instructions to the New Brunswick Electric Power Commission to prepare full plans and specifications for the development of the Grand Falls, on the St. John River, near the Maine border, have been issued. A start on the plans will be made at once. It will possibly be a year before tenders can be called for the erection of the plant, and it will be necessary to secure the permission of the International Joint Waterways Commission to build on international waters, and the Quebec Government to build dams on lakes in that province tributary to the St. John River.—*Reuter's Trade Service* (St. John, N.B.).

Continental.—BELGIUM.—In its report for last year, the Société du Chemin de Fer Electrique d'Ostende-Blankenberghe et Extensions states that the sale of electricity in Western Flanders increased from 8,303,000 kWh in 1922 to 10,650,000 kWh. A contract has been entered into with the authorities of the Province of Western Flanders for the supply of electricity required for the distribution system which is being established in the war-devastated area between Ypres and the sea. In order to meet the increasing demand for electricity, a new 5,000-kW turbo-alternator has been installed, bringing the capacity of the power station up to 10,500 kW, and an order has been placed for an additional 2,000-kW set.

FRANCE.—Dealing with the production, transmission, and distribution of energy, the report of the Union des Syndicats de l'Electricité states that 1923 witnessed the completion of a part of the installation at 150,000 volts for the Southern Railway, the beginning of the construction of the large 150,000-volt feeder for the Orleans Railway, and a considerable extension of the works in the region of Paris. In addition, there was placed in service the State network at 45,000 volts in the north of France, and new sections on the underground network at 60,000 volts in the district of Paris. The construction of several 120,000-volt lines was begun, especially those which will transmit to Lyons the energy produced by the Vizlaire works in the Alps. At present the length of extra-high-pressure lines in France amounts to 5,580 miles, of which 3,100 miles works at pressures ranging from 45,000 to 90,000 volts, and 2,480 miles at a pressure of 90,000 volts and upwards.

Croydon.—LOAN SANCTIONED.—The Town Council has received the sanction of the Electricity Commissioners to a loan of £61,000 for electricity purposes.

Dover.—LOAN.—The Town Council has applied to the Electricity Commissioners for sanction to a loan of £10,100 for the installation of a new boiler at the electricity works.

Eastbourne.—INAUGURATION OF NEW PLANT.—On April 28th the Mayor (Alderman G. B. Soddy, J.P.) inaugurated the new plant which has been added to the electricity works. This consists of a turbine by Messrs. W. H. Allen, Sons & Co., Ltd., driving a 2,500-kW alternator by the General Electric Co., Ltd., together with a surface condensing plant and auxiliaries.

Edinburgh.—NEW PLANT.—Owing to the increasing demands upon the new power station at Portobello, it is anticipated that the plant will be working to full capacity in a few years' time, and it has been found necessary to consider extensions. With this in view, a deputation from the Electricity Committee has visited the principal stations in the country, and at a meeting of a sub-committee on Wednesday it was agreed to recommend the installation of a 15,000-kW generator, with the necessary boilers. It is intended that the additional plant, the estimated cost of which is £157,000, shall be ready for the winter of 1925-26. At present the station has three generating sets, each of 10,000 kW.

Hamilton.—ELECTRICITY SUPPLY.—Edmundson's Electricity Corporation, Ltd., has drawn the attention of the Corporation Electric Lighting Committee to the necessity for providing additional cables, and for further plant at the electricity works, or an increased supply from the Clyde Valley Co., and the Committee recommends that the extensions should proceed and that Messrs. Buchan & Partners should be instructed to submit recommendations with estimates as soon as possible.

Mr. Hogarth, having suggested that the Council should consider the question of a hydro-electric plant at Motherwell Bridge, has been instructed to report on the scheme and its probable cost.

Horsham.—ELECTRICITY SUPPLY.—In order to provide work for the unemployed during the winter 1924-25, the Electricity Committee has recommended the laying of a new feeder cable at an estimated cost of £3,000, and the installation of an additional 170-kW generator coupled to a 250-h.p. Diesel heavy oil engine at a cost of £4,600.

Hull.—ELECTRICITY EXTENSIONS.—The Corporation Electricity Committee has under consideration a proposal to extend the generating and distributing plant and mains at an estimated cost of £320,153, and application is to be made to the Unemployment Grants Committee for a grant towards the scheme.

Irish Free State.—KILKENNY.—At a recent public meeting a resolution was passed, requesting the Corporation to promote an electricity scheme for the district, the cost to be raised by a special rate.

ENNISKILLEN.—A company has been formed for the purpose of carrying out an electricity scheme for the district.

Knaresborough.—LOAN.—The Urban District Council is applying to the Electricity Commissioners for sanction to the borrowing of £7,000 in connection with the electricity scheme for the district.

Leatherhead.—SPECIAL ORDER.—The Leatherhead and District Electricity Co., Ltd., has applied to the Electricity Commissioners for a Special Order authorising it to extend its area of supply so as to include certain parishes in the rural district of Guildford.

Luton.—LOAN SANCTIONED.—The Town Council has received the sanction of the Electricity Commissioners to a loan of £30,000 for plant.

Midsomer Norton.—ELECTRICITY SUPPLY.—The Urban District Council has decided to support the application of the Western Electric Distributing Corporation, Ltd., for an Order to supply electricity to the town. The company proposes to erect a power station in the Radstock district.

Newmill.—LOAN.—Application has been made to the Electricity Commissioners by the Urban District Council for sanction to the borrowing of £9,000 for electricity purposes.

Nuneaton.—SPECIAL ORDER.—The Corporation is applying to the Electricity Commissioners for a Special Order authorising it to extend its area of electricity supply so as to include the parishes of Hartshill and Weddington.

Perth.—LOAN.—The Town Council is applying to the Electricity Commissioners for sanction to the borrowing of £8,500 for electricity purposes.

Price Reductions.—HENDON.—*The Hendon Electric Supply Co.*—Lighting: 4d. per kWh. Domestic purposes: First 120 kWh per quarter, 2½d. per kWh; all additional energy, 1d. per kWh.

Scotland.—HYDRO-ELECTRIC SCHEME.—It is anticipated that the scheme for harnessing the watershed of Ben Nevis will be put in hand this summer. The work, which will include the erection of a power station at Fort William, is to be carried out by the North-British Aluminium Co. a subsidiary organisation of the British Aluminium Co., Ltd., and it will take from three to four years to complete the project. The estimated cost of the scheme is £5,000,000, of which the Government is guaranteeing £2,000,000.

Shaftesbury.—SPECIAL ORDER.—Application is being made to the Electricity Commissioners by Mr. J. G. Royce for a Special Order authorising him to supply electricity in the borough of Shaftesbury, the Urban District of Shepton Mallet, the Rural Districts of Shaftesbury, Sturminster, Shepton Mallet, and Wincanton, and certain parishes in the Rural Districts of Blandford and Langport.

Southampton.—LOAN.—The Electricity Committee has recommended the Town Council to apply to the Electricity Commissioners for sanction to a loan of £26,672 for cables and other equipment in connection with the electricity supply to Portswood and Eastleigh.

United States.—HYDRO-ELECTRIC DEVELOPMENT.—According to *Power*, an application for a licence has been filed with the Federal Power Commission by the Columbia Valley Power Co. to cover its proposed development on the Deschutes River in Central Oregon. The company states that it is ready to proceed with the construction of the works to be erected on the Pelton site, where it is planned to develop 51,000 h.p. On completion of this portion of the project, the company intends to proceed with work on the Metolius dam, the larger part of the scheme, where it is proposed to develop 120,000 h.p.

Wimborne.—SPECIAL ORDER.—The Bournemouth and Poole Electricity Supply Co., Ltd., has applied to the Electricity Commissioners for a Special Order authorising it to extend its area of supply so as to include the urban district of Wimborne Minster and certain parishes in the rural districts of Poole and Wimborne and Cranborne.

Tramway and Railway Notes.

Continental.—FRANCE.—According to the report of the Compagnie des Tramways de Reims for the past year, the company is now operating four lines of electric tramway, with a total length of about 11¼ miles. The number of passengers carried increased from 8,372,830 in 1922 to 9,675,750, and the number of car-kilometres run from 1,264,425 to 1,423,847.

In connection with the electrification of the Paris suburban railways, the portion from Saint-Lazare to Bois-Colombes and Bécon-les-Bruyères was brought into operation on April 27th.

SWITZERLAND.—A serious accident happened in the early hours of April 23rd between Biarritz and Milan expresses on the St. Gothard line outside the station of Bellinzona (eight miles north-east of the head of Lage Maggiore), in which it is estimated that 15 people were killed and over 50 injured. Drawn by two electric locomotives, one train collided head-on with the other, also drawn by two engines. Most of the casualties were in a German sleeping car; when the collision occurred a gas cylinder under the carriage burst and the passengers were burned before they could be liberated. Swiss railway stock is electrically lighted.

Darlington.—PROPOSED RAILLESS CARS.—Mr. A. Baker, general manager of the Birmingham Corporation Tramways, has presented his report on the question of the passenger transport service in Darlington. The report strongly favours the adoption of the railless-car system, as, with the exception of the Haughton route and the new loop in Woodlands Road, the tramway track is practically worn out. To reconstruct the track would cost about £100,000, and to carry out the proposed extensions through Cockerton would cost approximately another £100,000. The cost of the railless-car system would be about £60,000, and the revenue from this system would be sufficient to meet the capital charges and provide for depreciation. A deputation is to visit Birmingham and Wolverhampton for the purpose of inspecting the railless-car systems there.

Java.—RAILWAY ELECTRIFICATION.—According to *Commerce Reports*, rapid progress is being made by the railway authorities with the electrification of the principal lines. The completion of the work of constructing the power house at Tjibadak, near the city of Soekaboemi, and the transmission line from the power house to Batavia, a distance of 100 km., is expected to take place by the end of June. In addition to supplying power to the Batavia loop line, the plant at Tjibadak, which will distribute at 70,000 V, will also supply electricity for the city of Batavia and for Soekaboemi. The present plant of the Batavia Electric Light Co. will be kept as a reserve station.

London.—ACCIDENT.—A collision occurred on the London, Midland & Scottish Railway on April 26th at about 8 a.m. between an excursion train from Coventry and an electric train from Watford. The Coventry train had stopped in a tunnel about half a mile outside Euston station, and was run into by the electric train. The front and rear carriages of the trains were derailed and several of the lines were blocked. Four passengers were killed and over 40 injured. An inquiry into the accident was to be opened by the Ministry of Transport on April 30th.

Wolverhampton.—RAILLESS CARS.—The Town Council has confirmed a recommendation of the Tramways Committee that a railless-car service be introduced on the Bushbury route, at an estimated cost of £19,702, in lieu of the reconstruction of the existing track.

Telegraph and Telephone Notes.

Australia.—EMPIRE RADIO COMMUNICATION.—Commenting on the report of the Donald Committee on Empire radio communication, the Prime Minister (Mr. Bruce) said that there was no proposal to abandon the agreement made in Australia with Amalgamated Wireless (Australasia), Ltd., for the establishment of direct radio communication with Great Britain. Not only was this a fact, Mr. Bruce explained, but there was no suggestion that the Commonwealth should join in another Empire radio undertaking. It was, of course, a domestic question to determine how Great Britain was going to erect the long-distance stations. The only ground which the Commonwealth had for interfering with those plans was that Australia was entitled to demand that Great Britain should erect reciprocal stations, or allow them to be erected, or facilities for handling the Commonwealth traffic should be granted in Britain.—*Reuter* (Melbourne).

Chile.—TELEPHONE CONCESSION.—The Chile Government has declared that it will renew the English company's telephone concession, which ends this year, only if a guarantee is given of an improvement of the services. Meanwhile a group of Chileans is organising a company capitalised with 30,000,000 pesos and promising a modern service in the city and suburbs. —*Financial Times.*

Italy.—AUTOMATIC TELEPHONES.—Arrangements have been made for a loan of 5,000,000 lire by the city of Milan to the Italian Ministry of Posts and Telegraphs to complete the work already commenced of installing 14,000 automatic telephones in two important districts in the city. The Ministry had granted concessions for this work to private interests, which were unable to complete the installation because the Ministry could not make partial payments as the work progressed. All revenue obtained from the telephones in question will be taken by the city of Milan until the loan has been paid. The arrangement is not incompatible with the general scheme under consideration by the Italian Government to re-lease all Government-owned telephone systems to private enterprise.—*Commerce Reports.*

Radio Direction-finding.—NEW STATIONS.—The Post Office intimates that facilities for direction-finding will be provided at once by the radio stations at The Lizard, Berwick, and Flamborough Head, while other stations will be opened shortly. The service should be of the greatest value to mariners particularly in the North Sea and the Channel.—*Daily Mail.*

Russia.—LONG-DISTANCE TELEPHONY.—It is announced that the Soviet Government intends to inaugurate a telephone line between St. Petersburg and Stockholm.—*Reuter* (Moscow).

Transpacific Radio Communication.—SUCCESSFUL TESTS.—It is reported that the experiments which Commander E. C. Watson, representing the Pacific Cable Board and the British Post Office, has been conducting from the coast of British Columbia to Australia, *via* Fanning Island, have met with success and are likely to be extended.

Radio Notes.

A New Valve.—FOUR-ELECTRODE TYPE.—According to the daily Press what are claimed to be a new valve and improved receiving circuit have been evolved by Messrs. G. V. Dowling and K. D. Rogers. The new valve dispenses with the use of a h.p. battery and it can be adapted to any existing circuit. It employs four electrodes and the potential of the initial current flowing round the anode circuit is stepped up and applied to an extra grid which is very near the filament. The extra grid is made more positive by being connected with the positive terminal of the l.p. battery.

Broadcasting the King's Speech.—In connection with the broadcasting of the King's speech at the opening of the British Empire Exhibition at Wembley (the first occasion on which a speech by his Majesty has been broadcast), the *Daily Mail* arranged for Marconiphone and Amplion loud-speaker equipment to be installed at 27 places in London, in 133 county towns, and in 15 Scottish towns, thus enabling large numbers of people who do not own radio receivers to hear the speech.

The "Audivox" and "Magnavox" loud speakers, made by the Sterling Co., were used in connection with Marconiphone receiving apparatus in a large number of the public demonstrations that were organised.

We are informed that in order that all the employés of the firm of Messrs. A. Reyrolle & Co., Ltd., electrical engineers, Hebburn-on-Tyne, might have an opportunity of hearing the King's speech at the opening of the British Empire Exhibition, the directors of the company closed the works at 11.20 a.m. Loud speakers were installed in various parts of the shops, in both the old and the new factory. The various speeches were heard quite distinctly, and were much enjoyed.

International Radio Telephony.—CONFERENCE AT GENEVA.—The preliminary conference for the drawing-up of an international radio telephony agreement opened at Geneva on April 22nd. M. Maurice Rambert, president of the Swiss Radio-Electric Society, welcomed the foreign delegates and the representatives of the Swiss authorities and the League of Nations International Labour Office. M. Isbruecker (Holland) was appointed president of the Conference. M. Haas, director of the Transit Section of the League of Nations, declared that the committee of experts appointed by the League of Nations Transit Commission had emphasised the necessity of calling an international conference to revise the Convention on radio-telegraphy drawn up in London in 1912. Several speakers, among them Mr. Edmonds, the representative of the London *Wireless World*, gave accounts of the radio telephone situation in their respective countries. The principal aims of the Conference are the preparation of new international agreements on the allotting of wave-lengths, the adoption of an international auxiliary language, and the organisation of a European centre for transmitting stations.

The preliminary Conference concluded its labours on April 23rd. It has formulated the following conclusions:—(1) That certain wave-length fields should be exclusively reserved to radio telephony and that those allotted to radio telegraphy should be clearly differentiated; (2) that, in view of the considerable contribution made by amateurs to the development and progress of radio telephony, their rights should be taken into consideration and certain fields reserved for their experiments; (3) that the use of "deadened" waves should be exclusively confined to ships' distress signals and time signals.

The Conference begs the League of Nations and the Universal Telegraphic Union to do everything possible to hasten the meeting of another inter-governmental conference, and urges all radio-telephonic organisations to create a movement of public opinion and address petitions to their Governments urging them to approach Geneva and Berne so that the summoning of the convocation may be hastened.

A resolution was also adopted proposing that all stations should, at least once a week, transmit a short programme in Esperanto. It was also urged that efforts should be pursued towards bringing about an international agreement regarding radio telephony and towards establishing a permanent link between transmitting stations and radio companies, and publications with headquarters at Geneva. In conclusion, the Conference expressed the hope that those States which forbid the use of radio telephony would reconsider their decision and license amateur stations.—*Reuter* (Geneva).

United States.—BROADCASTING MUSIC.—Broadcasting stations won a legal victory on April 23rd, when the District Court dismissed a petition by a firm of New York music publishers to prevent the broadcasting of copyright music unless royalties were paid. The judge declared that the rendition of a copyright piece of music in the studio of a broadcasting station to which the public was not admitted and could not come, and its conversion into sound waves that were received in the homes of owners of receiving sets, was no more a public performance than was the reproduction by a perforated music-roll of copyright music. Against the decision the Society of American Authors, Composers, and Publishers has decided to appeal in the Supreme Court.—*Daily Mail.*

AMATEUR SUSPENDED.—The Chief Wireless Federal Supervisor for the Middle West has ordered the dismantling for one year of amateur station 9 AQB, of St. Louis, on the ground that its owner not only "cluttered up the atmosphere with dots and dashes any time he chose," but also radiated impolite language.

Contracts Open and Closed.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared in our advertisement pages.)*

Open.

Belfast.—May 5th. Electricity Department. D.c. switchgear for sub-stations. (April 18th.)

Belgium.—May 8th. Municipal authorities of Schaerbeek. Transformer cabin in the Rue Van Hove. Particulars for 5 fr.

May 7th. Belgian State Railway authorities (Office de l'Electricité), 25, Rue de las Charitè, Brussels. 375,500 insulators in eight lots. Particulars (Cahier des Charges Special No. 4-7) for 1 fr. 15 c.

May 8th. Municipal authorities of Corswarem (Province of Limbourg). Establishment of a l.p. electricity distribution system in the town. Particulars for 25 fr. from Secretariat Communal.

Birmingham.—Board of Guardians. Electric wiring, &c., installation at the Selly Oak Hospital. Specifications, &c., from Messrs. Edwards & Shaw, Colmore Row, Birmingham.

Bri Chualann.—May 6th. Urban District Council. Electrical stores. (April 18th.)

Castlebar.—May 15th. County of Mayo Mental Hospital. Electric lighting of the Institution:—(1) Heavy oil engines; (2) dynamos; (3) storage battery; (4) switchboard; and (5) wiring mains and fittings. Chairman of committee, Mental Hospital, Castlebar.

Chile.—SANTIAGO.—May 26th. Chilean State Railways. Telephones, switchboards, copper and g.i. wire and cables, dry cells, insulators, &c.*

Colchester.—June 2nd. Electricity Department. 20-ton travelling crane, dry-back boilers, water-tube boilers, coal-conveying and handling plant, steel chimney, induced draught fans, turbo-alternators, condensing plant, pumps, rotary converters, transformers, e.h.p. and l.p., a.c., and d.c. switchgear, cable connections, valves, pipes, &c., feeder and pilot cables, transformers, and equipment for sub-stations. (April 25th.)

Edinburgh.—May 12th. Electricity Supply Department. Extensions to d.c. switchboard. (April 18th.)

May 19th. Electricity Supply Department. E.h.p. switchgear for sub-stations, 3-phase transformers. (See this issue.)

London.—LONDON COUNTY COUNCIL.—May 19th. Motor-driven belt-conveyor coal-handling plant for Greenwich power station. (April 18th.)

Maesteg.—May 27th. Urban District Council. L.p. overhead and underground distributing mains, switchgear, and suspension lighting of highways. (April 25th.)

New Zealand.—WELLINGTON.—June 17th. Public Works Department. Oil switches, relays, and current transformers for the Lake Coleridge scheme.*

June 24th. Twelve electric ranges for the Mangahao power scheme.*

Penang.—GEORGE TOWN.—May 20th. Municipal Commissioners. One 3,000-kW turbo-generator and condensing plant. (April 25th.)

Sheffield.—June 3rd. Electricity Department. Plant required in connection with the new generating station, buildings, and engineering works: steelwork, transformers, turbo-alternators, and condensing plant, water-tube boilers, with chimneys, superheaters, stokers, economisers, &c., pipework and valves, wagon tippers, conveyors and elevators, e.h.p. 3-phase switchgear, cooling towers, overhead electrically and hand-operated travelling cranes, battery shunting locomotive and accessories. (See this issue.)

South Africa.—JOHANNESBURG.—May 30th. Municipal Council. Motor converter and three rotary converters.*

KINGWILLIAMSTOWN.—July 8th. Borough Council. Electrical plant, steam-raising plant, steel buildings, h.p. cables.*

Southampton.—May 26th. Electricity Department. Coal-handling plant and bunker extensions, &c. (See this issue.)

Slaithwaite.—May 31st. Urban District Council. Four-core cables and joint boxes, service connections and pillars, street lighting cables and lantern fittings, sub-station switchgear and equipment, house service meters. (See this issue.)

Stockton-on-Tees.—May 5th. Electricity Department. Two 300-kVA, 3-phase transformers. (April 18th.)

Stoke-on-Trent.—May 14th. Electricity Department. Circulating water pipes and valves, steam pipes and valves. (April 18th.)

Uruguay.—MONTEVIDEO.—June 17th. Port authorities. Electric winch and capstans.*

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Closed.

Bedford.—Town Council. Accepted:—

3,750-kW turbo-alternator, complete with air filters, condensing plant, auxiliary machinery, and internal interconnecting pipe work (£17,620).—C. A. Parsons & Co., Ltd.

Belgium.—Three concerns—including the British Insulated & Helsby Cables, Ltd.—submitted tenders last week to the municipal authorities of Tamines for the supply and laying of a quantity of underground armoured cable; the lowest offer was that of the Société des Ateliers de Constructions Electriques de Charleroi, who quoted 75,030 fr. for the cables and 19,440 fr. for the laying.

Three Belgian concerns submitted tenders last week to the Belgian Post and Telegraph authorities in Brussels for the supply of two central-battery telephone switchboards. The lowest offer (21,303 fr.) was that of the New Antwerp Telephone and Electrical Works, of Bercham, Antwerp.

Coxhoe.—Parish Council. Accepted:—

Poles and plant for public lighting by electricity (£492).—Gray Bros.

Frodsham.—Joint Water Committee. Accepted:—

Motor, &c., for the Lordship pumping station (£246).—Messrs. Timmins.

Government Contracts.—The following Government contracts were placed during March, 1924:—

ADMIRALTY CONTRACT AND PURCHASE DEPARTMENT.

Aluminium ingots.—British Aluminium Co., Ltd.
Distribution and junction boxes, &c.—Ewart & Son, Ltd.; Hawkers, Ltd.; Player & Mitchell; L. Weekes, Ltd.; Johnson & Phillips, Ltd.; Accles & Pollock, Ltd.; W. McGeogh & Co., Ltd.
Electric welding equipment.—Handstock, Ltd.
Silica envelopes and caps for wireless valves.—Thermal Syndicate, Ltd.
Turbo-generators.—British Thomson-Houston Co., Ltd.
Motor-driven pump.—Drysdale & Co., Ltd.
Electric platform trucks.—Gillespie & Partners, Ltd.
Electrically-driven winches.—Napier Bros., Ltd.

AIR MINISTRY.

Alternator.—Parsons Motor Co., Ltd.
Electrical measuring instruments.—Weston Electrical Instrument Co., Ltd.
Generators.—W. Mackie & Co., Ltd.; G. R. Morley, Sprague & Co., Ltd.
Switchboards.—Erskine, Heap & Co., Ltd.
Valve unit.—Ricardo Engineers, Ltd.

POST OFFICE.

Telephone apparatus.—British Insulated & Helsby Cables, Ltd.; British L. M. Ericsson Mfg. Co., Ltd.; General Electric Co., Ltd.; Siemens Bros. & Co., Ltd.; Sterling Telephone & Electric Co., Ltd.; Telegraph Condenser Co., Ltd.; Western Electric Co., Ltd.
Wireless apparatus.—Marconi's Wireless Telegraph Co., Ltd.
Cables.—Callender's Cable & Construction Co., Ltd.; Connolly's (Blackley), Ltd.; Enfield Cable Works, Ltd.; W. T. Glover & Co., Ltd.; Hackbridge Cable Co., Ltd.; W. T. Henley's Telegraph Works Co., Ltd.; Pirelli-General Cable Works, Ltd.; Siemens Bros. & Co., Ltd.; Union Cable Co., Ltd.
Cells.—Fuller's United Electric Works, Ltd.; Siemens Bros. & Co., Ltd.
Ducts.—Albion Clay Co., Ltd.; Doulton & Co., Ltd.; Hepworth Iron Co., Ltd.; Oates & Green, Ltd.; Stanley Bros., Ltd.; Sutton and Co.; J. H. Turner & Lisney, Ltd.
Insulators.—Bullers, Ltd.
Wire.—Callender's Cable & Construction Co., Ltd.
Bronze wire.—Johnson & Phillips, Ltd.
Manufacture, supply, drawing-in, and jointing cable.—Maryland-Walthamstow, Wanstead-Woodford, and East Woolwich Junction: Siemens Bros. and Co., Ltd. Holborn-North Dalston-Tottenham Junction: W. T. Henley's Telegraph Works Co., Ltd. Nottingham-Mansfield: W. T. Henley's Telegraph Works Co., Ltd. Saxondale (Nottingham)-Grantham: Johnson & Phillips, Ltd.
Electric light and power installation.—Birmingham P.O. factory extension: Manley & Regulus, Ltd.
Storage battery.—Mount Pleasant sub-station: Tudor Accumulator Co., Ltd.
Telephone exchange equipment.—Bradford and District Newspaper Co., Ltd. (Bradford): Relay Automatic Telephone Co., Ltd. Messrs. Salts, Ltd. (Saltaire): Relay Automatic Telephone Co., Ltd. Oxendale and Co., Ltd. (Manchester): Relay Automatic Telephone Co., Ltd. Messrs. J. & N. Philips & Co., Ltd. (E.C.): Relay Automatic Telephone Co., Ltd. Dalston: Western Electric Co., Ltd. Liverpool (Central): Western Electric Co., Ltd. Tilbury: Western Electric Co., Ltd.; sub-contractors for batteries: Tudor Accumulator Co., Ltd.; for charging machines: Electric Construction Co., Ltd.; for ringing machines: Crompton & Co., Ltd.

CROWN AGENTS FOR THE COLONIES.

Diesel engine.—English Electric Co., Ltd.
Insulated cable, &c.—Callender's Cable & Construction Co., Ltd.
Motors.—Laurence, Scott & Co., Ltd.
Telephones.—British L. M. Ericsson Mfg. Co., Ltd.

Liverpool.—According to *The Times*, the Mersey Docks and Harbour Board has placed an order for 31 electric cranes for the new Gladstone Dock with Messrs. Stothert & Pitt, Ltd.

Luton.—The Town Council has confirmed the provisional contract with the Brush Electrical Engineering Co., Ltd., for a 7,000-kW turbo-alternator at £25,300.

Trowbridge.—Board of Guardians. Accepted:—

Installing electric light at the Institution (£430).—King & Co.

Whitehaven.—Accepted:—

Electrical installation at Midland Bank.—T. S. Bell & Co.

Forthcoming Events.

Faraday House Old Students' Association.—Friday, May 2nd. At the Hotel Cecil, Strand, W.C. At 8 p.m. Annual smoking concert.

London and Home Counties Electricity District.—Monday, May 5th, at the Institution of Electrical Engineers, Victoria Embankment, W.C. At 10.30 a.m. Electricity Commissioners' Inquiry.

Society of Engineers.—Monday, May 5th. At Burlington House, W. At 5.30 p.m. Paper on "Some Factors of Sea Defence Work," by Mr. C. H. J. Clayton.

Institute of Transport.—Monday, May 5th. At the Institution of Electrical Engineers, Victoria Embankment, W.C. At 5.30 p.m. Paper on "Scientific Research and Transport," by Prof. F. C. Lea.

Junior Institution of Engineers.—Tuesday, May 6th. At the Monico Restaurant, Piccadilly Circus. At 6.30 for 7 p.m. Annual dinner.

Engineers' Club.—Tuesday, May 6th. At the Connaught Rooms, Great Queen Street, W.C. At 7 for 7.30 p.m. First annual dinner.

Royal Society of Arts.—Wednesday, May 7th. At John Street, Adelphi, W.C. At 8 p.m. Paper on "Wireless Navigation of Ships and Aircraft," by Mr. J. Robinson.

Institution of Electrical Engineers.—Thursday, May 8th. At Savoy Place, Victoria Embankment, W.C. At 6 p.m. Annual general meeting.

(Wireless Section).—Wednesday, May 7th. At the Institution, Savoy Place, W.C. At 6 p.m. Paper on "Faithful Reproduction in Radio Telephony," by Mr. L. C. Pocock.

(Western Centre).—Joint meeting with the Association of Mining Electrical Engineers (South Wales Branch). Saturday, May 3rd. At the New Electric Power Station of the West Gloucestershire Power Co., Lydney. At 3.30 p.m. Paper on "Some Researches on the Safe Use of Electricity in Coal Mines," by Prof. W. M. Thornton.

(London Students' Section).—Friday, May 9th. At the Institution, Victoria Embankment, W.C. At 6.30 p.m. Annual general meeting. Paper on the "Northolt Radio Station," by Mr. A. C. Warren.

Iron and Steel Institute.—Thursday and Friday, May 8th and 9th. At the Institution of Civil Engineers, Great George Street, S.W. At 10.30 a.m. each day. Annual meeting.

May 8th. At the Hotel Cecil. At 7 p.m. Annual dinner.

Physical Society of London.—Friday, May 9th. At the Imperial College of Science, South Kensington, S.W. At 5 p.m. Ordinary Scientific Meeting.

The "Electrical Review" Service Department.

WE should be glad to learn the names of makers or suppliers of:—

FAMA wireless valves.

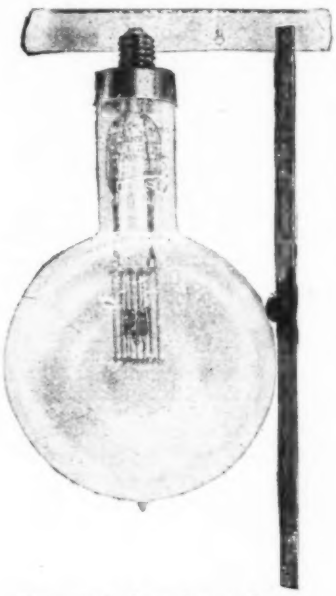
Notes.

Over-water Transmission Line.—Japan will soon have the longest over-water electric transmission line in the world—a 100,000-volt line between the island of Shikoku and the mainland, 23 miles away. Intervening islands will carry the towers.—*A.I.E.E. Journal.*

National Illumination Committee.—The report of the chairman of the National Illumination Committee of Great Britain (Lt.-Col. K. Edgcumbe) for 1923, commences with reference to the death of M. J. Violle, whose work on the platinum standard of light was of great importance; he was honorary president of the French National Committee of Illumination. In response to a suggestion that a Section Committee on Illumination should be formed, the British Engineering Standards Association last year called a conference of representatives of organisations interested in the matter. As a result the Association is forming such a Sectional Committee with the National Illumination Committee as a nucleus. It is hoped that in this way technical and industrial interests will be brought together, securing a more general representation. During the year the Sub-Committee on Headlights successfully aimed at finding a common basis for the comparison of British and American proposals. The Sub-Committee hope to be in a position shortly to obtain a comparison between headlights constructed in accordance with each proposal, from the points of view both of freedom from glare and of efficiency as driving lights. Modifications in definitions have been considered, and it is hoped that the Committee will be able to place concrete proposals before the next meeting of the International Committee, which is to be held in Switzerland (Geneva) from July 21st to 26th, instead of in the United States as originally proposed.

Fatality.—Louis Slattery was killed by electric shock at the British Thomson-Houston works at Rugby on April 26th, while standing on a platform 4 ft. from the ground in the testing department.—*Evening News.*

Extremes in Lamp-making.—The accompanying illustration depicts the largest and smallest lamps manufactured by the General Electric Co., Ltd., and demonstrates very well the widely-differing uses to which incandescent electric lamps



Extremes in Incandescent Lamps.

can be put. The large lamp is used in the South Foreland Lighthouse, and it consumes 4 kW at 80 V. The diminutive lamp is for surgical use, and can be used for the examination of a patient's throat, &c.

The British Industries Fair.—As the British Empire Exhibition has been rightly described as the Empire's shop window, so can the British Industries Fair be equally well designated its business office, for while the general public is examining the Empire's products at Wembley trade buyers will be found at the Fair ordering their stocks for the ensuing year. The present Fair is the tenth annual show organised by the Overseas Trade Department, but at the White City this year (the London Section will be open from April 28th to May 9th, followed by the Birmingham Section from May 12th to 23rd), there is little of electrical interest, as is perhaps natural when the engineering exhibits are to be displayed at Birmingham.

Prince's Electrical Clocks, Ltd., as the name implies, has on view a large electrically-operated clock, while B.D.S. Wireless, Ltd., displays "Mozzullphone" radio sets and components, transformers, amplifiers, variometers, &c., for the home and export trade. Messrs. Ellis & Sons (1923), Ltd., (sole concessionaires: G. Gilliver & Co., Ltd.), show "Erinoid" products, violet-ray apparatus, small power transformers, wound coils, &c., and the Transflector Co., Ltd., exhibits flashing electric showcases, signs, &c. Mr. J. W. Butcher shows optical and kinema lantern slides for advertisement and general purposes, together with the "Practicon" electric arc lamp. Amongst the display of Messrs. Hirst Bros. & Co., Ltd., crystal and valve radio receiving sets are to be seen, and Messrs. Needham Bros. again show several of their electric water fountains for decorative purposes. Mr. E. Simons also shows radio receivers of various sizes.

Messrs. J. J. Eastick & Sons are also exhibiting a range of wireless and electrical goods.

Messrs. John Moncrieff, Ltd., exhibit laboratory glassware, gauge glasses, miners' lamp glasses, &c., while several firms show decorative porcelain and glassware for illumination purposes, such as vases, bowls, candlesticks, &c., amongst which may be mentioned Messrs. Thos. Webb & Son; Thos. Webb and Corbett, Ltd.; John Walsh, Walsh, Ltd.; Stevens and Williams, Ltd.; and H. G. Richardson & Sons, while the Derbyshire Spar and Alabaster Works show alabaster bowls for indirect lighting amongst vases and other novelties.

"Mystery" revolving lamp shades for advertisement are to be seen on the stand of Messrs. Livermore & Knight, Ltd., and hand-painted, silk, and other sorts of electric lamp shades are displayed by Messrs. S. L. Miller & Co.; Speights, Ltd.; and Henry Wolff & Co.

The Tirso Dam.—On Monday last week, the King of Italy opened the second largest dam in the world—the Tirso Dam, known to the workmen as the St. Chiara Dam in honour of the chief engineer's wife—in the Island of Sardinia. This dam is extremely interesting from many aspects. The recent Glene disaster, which took toll of some 300 lives, drew universal attention to the new dam, as the two are constructed on the multiple-arch system. There are 18 buttresses, the central ones being 228 ft. high, with base 244 ft. deep. The spans between the buttresses are closed in with rounded faces inclined at an angle of 57 deg., so that the load of the dam is vertical to the weight of the overhead water, this greatly aiding stability. The total length of the wall is 722 ft., with cubical contents equal to 2,060,100 cu. ft.

The water is derived from the River Tirso, which has a catchment area of some 900 sq. miles. The artificial lake thus formed is over 16 miles long and averages 1¼ miles broad, the contents being 4,897,152,000 cu. ft. This makes it the second largest in the world, the first, of course, being that constructed by England at Assuan on the River Nile. Prior to this, Italy's largest storage lake contained less than one-tenth of this volume. For 229 days in the year, only from 11 to 36 cu. ft. per second will flow to the turbines; but for the remaining 136 days the average flow will rise to 729 cu. ft. per second. The general average for the year will amount to 235¼ cu. ft. per second.

The plant for the utilisation of the fall is contained within the arches. There are four turbines, two of 9,000 h.p. and two of 6,000 h.p., giving a maximum power of 30,000 h.p., while the year's average will be some 10,000 h.p. The pressure of generation at present is 5,000 volts at 50 cycles, but this will shortly be stepped up to 75,000 volts. There is a fifth group of generators for auxiliary purposes. The annual output is estimated at more than 50 million kWh, averaging 500 kWh per head, as against 300 kWh in Lombardy, one of the best-served provinces in Europe. The purpose of this dam is to provide electricity for the smelters of the copper mined at Gadoni, the iron from Nurra and Jersu, and the zinc which is found here in large quantities. In addition to this, there will be sufficient water to irrigate close upon 100,000 acres of grain-producing land, an area greater than that of the whole of the Isle of Wight. The projector of this great work is Engineer Omodeo. The scheme was examined by engineers Kambo and Costamagna, while the carrying-out of the work has been in the hands of Engineer G. Dolcetta, the engineer-in-chief of the "Imprese Idrauliche ed Elettriche del Tirso." The Minister for Public Works has instructed Sig. Omodeo to present a scheme for the construction of 16 new reservoirs in the island capable of producing 600,000,000 kWh annually. This will make Sardinia electrically the richest region in the world.

Appointments Vacant.—Electrical engineer and manager (£700) for the Great Yarmouth Corporation electricity undertaking; Cable Jointers (£400), for the Government of Nigeria; Assistant for the test room and meter department (£350), for the Aberdeen Corporation electricity department; Plumber-Jointer, for the Salford Corporation electricity department; Maintenance Engineer (Electrical), for South Africa Railways and Harbours Administration; charge engineer, for the Dewsbury Corporation electricity and tramways department. (See our advertisement pages to-day.)

The Budget.—On Tuesday last, Mr. Philip Snowden, Chancellor of the Exchequer, introduced the Government's financial proposals for the current year. In addition to the partial remission of a number of food taxes and the entertainment tax, and the abolition of inhabited house duty, the Chancellor proposes to allow the "McKenna duties" (on imported motor-cars, clocks, &c.), to lapse on August 1st, to reduce telephone charges, and to abolish the corporation profits tax.

The reductions in the charges for telephone calls amount to 20 per cent. in the case of local calls, and from *nil* to as much as 25 per cent. for trunk calls.

No increases in any direction are proposed, and income tax remains practically unchanged.

The Engineers' Club (London).—Amongst those attending the first annual dinner of the Engineers' Club will be Mr. Frank Hodges, M.P., Sir Philip Lloyd-Greame, M.P., Sir Arthur Durrant, Brigadier-General Sir William Horwood, Sir Malcolm McAlpine, Sir Richard Redmayne, Mr. W. H. Patchell, and Prof. T. Turner.

Arrangements have been made to admit ladies, accompanied by members, every Saturday for lunch, tea, and dinner.

Local Societies.—POWER FACTOR.—A paper on "Power Factor for the Colliery Electrician" was recently read by Mr. W. G. Hunter to the West of Scotland Branch of the Association of Mining Electrical Engineers in Glasgow. Mr. Hunter explained how power factor could be increased, and showed the advantages which could be effected. He pointed out that if the power factor was raised by installing a static condenser, the cost of the condenser would be wiped out in less than three years. The following office bearers were elected: Chairman: Mr. David McQueen, chief engineer to the United Collieries, Ltd. Vice-chairmen: Messrs. G. E. Hart and D. Landale Frew. Treasurer: Mr. C. L. Brown. Hon. assistant treasurer: Mr. John A. Brown. Hon. auditor: Mr. T. Boyes. Hon. secretary: Mr. Jeffrey Aitken.

ELECTRIC LIFTS.—Mr. C. A. Munson delivered a lecture on "Electric Lifts" before members of the Birmingham Electric Club recently, when he made special reference to the erection and control of low-speed and high-speed lifts. Particulars were given of the lift requirements of tall buildings in America, where lift speeds of 800 ft. per minute are used.

Late Legal.—BRITISH THOMSON-HOUSTON CO., LTD., *v.* BRITISH INSULATED & HELSBY CABLES, LTD.—The appeal of the defendants from the judgment of Mr. Justice Russell, sustaining the plaintiffs' allegations of infringement of their drawn tungsten wire patent, was continued before the Master of the Rolls, and Lords Justices Atkin and Sargant on April 29th.

Sir Arthur Colefax, K.C., on behalf of the respondents, read the evidence given before Mr. Justice Russell in support of respondents' case.—Proceeding.

BRITISH RADIO SALES CO., LTD.—In the Companies (Winding-up) Court on April 29th, Mr. Justice Romer made an order for the compulsory liquidation of this company, on the petition of the British Broadcasting Co., Ltd.

RE-ECHO ELECTRICAL MANUFACTURING CO., LTD.—On the same occasion the same petitioners asked for the compulsory liquidation of this company, but his Lordship adjourned the petition for 14 days upon receiving the information that the company had decided upon voluntary liquidation.

Exide Ignition.—It is of interest to note that in the motor-car Gold Cup race at Brooklands on April 21st, the first and second cars, *i.e.*, Mr. A. Champion's Isotta-Maybach and Mr. E. A. Eldridge's Fiat, were both equipped with Remy ignition apparatus, using Exide batteries.

Institution Notes.

Institution of Electrical Engineers.—ANNUAL GENERAL MEETING.—The annual general meeting will be held on Thursday, May 8th, 1924, at 6 p.m., at the Institution Building, to receive and consider the accounts for the year ended December 31st, 1923, and the annual report of the Council, and to elect auditors.

ANNUAL CONVERSAZIONE.—The annual conversazione will be held on Thursday, June 26th, 1924, from 8.30 to 11 p.m., at the Natural History Museum, South Kensington, S.W.

MODEL CONDITIONS OF CONTRACT.—The Council has issued (*a*) a model form of General Conditions intended to cover the main conditions for Home contracts for the sale of goods and materials, other than cables, without erection; and (*b*) a model form of General Conditions intended to cover the main conditions for Home contracts for the sale of cables without erection. It is hoped that in order to secure the advantage of uniformity and to avoid trouble and expense they may be found suitable in their entirety for the majority of Home contracts for sale without erection. Copies of these conditions may be obtained from the secretary of the Institution, Savoy Place, Victoria Embankment, W.C.2, and from Messrs. E. & F. N. Spon, 57, Haymarket, S.W., price sixpence each set (post free).

The Kelvin Lecture.

FOLLOWING the presentation of the Faraday Medal on April 24th, Dr. G. Semenza delivered the Kelvin lecture.

Dr. SEMENZA, who is the president of the International Electrotechnical Commission, said he was only an engineer and not a scientist; therefore, he must be excused if he spoke only as an engineer. Lord Kelvin, then Sir William Thomson, announced his law on conductors in a paper read at the British Association meeting of 1881, and in describing this law the paper stated that the most economical area for a conductor was one for which the annual interest on the cost of the copper equalled the annual cost of the corresponding energy wasted. This law, in its simple form, had been judged by some people to be of very little practical value, on the ground that it neglected a number of factors which entered into the total cost of generation, such as poles and insulators, which varied with the size of the conductors. It was this fact which had taken away some of the practical value of the law. Personally, however, he had never thought such a view was a just one, and he therefore proposed to make an effort in the lecture to put Kelvin's law for conductors in its proper light.

Kelvin's law was interesting for two main reasons: First, because of its relation to the intellectual character of the man they were honouring that evening and, second, the development of the law with regard to everyday work. In order to appreciate the true value of the law, continued Dr. Semenza, it was necessary to go back to the time before it was enunciated, and in this connection reference was made to early networks and to the fact that economic considerations were not brought into play. Special reference was made to a remark by Edison in 1880 that he had no use for mathematics because he could guess a great deal closer than they could figure. Therefore, Edison went on guessing. Thus it was that things went on in an empirical rather than a scientific manner. For years there had been intense research into the problems of electricity, until there came the Glasgow professor who calmly asked a question that had not been thought of—how was the size of the conductor to give the maximum economy in transmission to be determined. It was then, no doubt, that Kelvin foresaw the possible developments of electrical transmission over long distances and that electric lamps would be as common as candles. In his 1881 paper Thomson had discussed the possibility of transmitting 21,000 h.p. from Niagara to a distance of 300 miles. It did not appear, however, that Thomson gave any further attention to the subject, which was later taken up by Prof. Forbes and Prof. Kapp, both of whom developed the law and applied it to practical cases. Those who had to deal with complicated problems, however, did not fully understand the importance of the law, and came to the conclusion that it was not of great use, preferring to solve their problems by tentative methods or guesswork. Some of the objections taken to Kelvin's law he did not agree with because they were against the spirit of engineering. The proper application of Kelvin's law to the determination of the most economical area of conductors had been largely developed during the past 20 years, and he did not propose to enlarge upon that. He would, however, endeavour to show how the law could be applied and how it had, in fact, permeated neighbouring fields.

In the case of hydro-electric plant, for instance, some very interesting problems arose. These installations could be divided into two classes, *viz.*, those which employed the ordinary flow of the water source, and those which employed a reservoir, whilst added to those two was the further case in which auxiliary steam plant was used. Dr. Semenza showed how Kelvin's law could be brought into play in determining, according to the particular circumstances, which of those three methods would be the most economical. He dealt in the same way with overhead-line construction, and justified the use of the somewhat narrow lattice construction adopted. He said that experience had shown, what theory had previously suggested, that the length of span had no influence on the safety of the line, and so much was this being recognised that public administrations were relaxing their regulations insisting upon short spans at road crossings. Obviously, however, the longer span involved heavier poles.

A number of diagrams were shown illustrating the manner in which costs can be calculated, certain formulæ also being shown. The final example taken was that of calculating the most convenient voltage for a transmission line, and here, again, the question of allowing for corona and Joule effects was gone into and worked out on the basis of Kelvin's law. It was shown when the area of the conductor would have to be increased for a particular service, and the circumstances were referred to in which the corona effect alone was taken into account in making the calculations and those in which both the corona and the Joule effects should be taken account of. Mostly, said Dr. Semenza, the calculations for overhead lines had taken into account only the avoidance of the corona effect.

Reference was then made to the spacing of conductors on high-pressure lines which, said the lecturer, was mostly a matter of personal judgment on the part of the designing engineer; however, he preferred a graphical method of arriving at the desired result. It was added that the Kelvin principle had been also successfully applied to hydraulic problems, such as the determination of the most convenient diameter of penstock, and in such problems as the determination of the best distribution of the losses between iron and copper in transformers, and in the case of traction with regard to the most convenient spacing of sub-stations, and so on.

Dr. Semenza said he did not know whether he had succeeded in giving a sufficient explanation of the manner in which Kelvin's law was being developed and of the utility of using the methods which had been evolved from it. All he could say was that the effort of trying to do so had given him the deepest satisfaction, as he looked upon it as a tribute to the memory of the great master they were there to honour. Finally, Dr. Semenza, after some personal references to the occasions when he had met the late Lord Kelvin, and to some quotations from the writings of Leonardo da Vinci as indicating similarity of thought of two great men who lived 400 years apart, said it was to science that they must look for a peaceful solution of the difficulties due to there being so many different nationalities, for science was the strongest international bond.

Mr. W. M. MORDEY, proposing a vote of thanks to Dr. Semenza, said they were all proud, as electrical engineers, that Kelvin was twice president of the Institution. When he died in December, 1907, he was then president for the second time. Kelvin's last appearance at the Institution was on the occasion of a paper by Mr. Highfield on high-pressure direct-current generation, a subject Mr. Highfield was still working at. Lord Kelvin took part in the discussion, and said he did not believe in alternating current, and had always believed in direct current, and that he had never swerved from that opinion; they were seeing now that there was more truth in that view than many thought at the time.

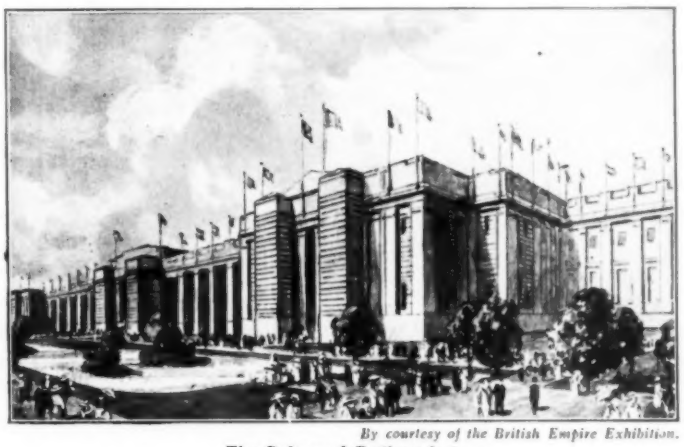
Mr. ROGER T. SMITH, in seconding the vote of thanks, said it was appropriate that the president of the International Electrotechnical Commission should give a Kelvin lecture, because nothing was so international in applied science as electrical engineering. Kelvin appealed to both Continental and English engineers because he combined in an extraordinary way the genius of an acute analytical mind with the practical constructive mind of the engineer. He was never happy unless he could make a model of his mental conceptions.

The British Empire Exhibition.

No finer display of Electrical and Allied Engineering Work has ever been brought together.

The world has seen many great exhibitions during the last thirty or forty years, but never before has it witnessed the actual fulfilment of so grand a conception as the British Empire Exhibition, whose gates were thrown open to the public last week.

Regarded in its entirety, it is one grand united effort of the British Empire to express itself—each part demonstrating its individuality, its natural and other resources, its human character, and its industrial capacity, all contributing their quota to the completeness of the Imperial Whole.



By courtesy of the British Empire Exhibition.

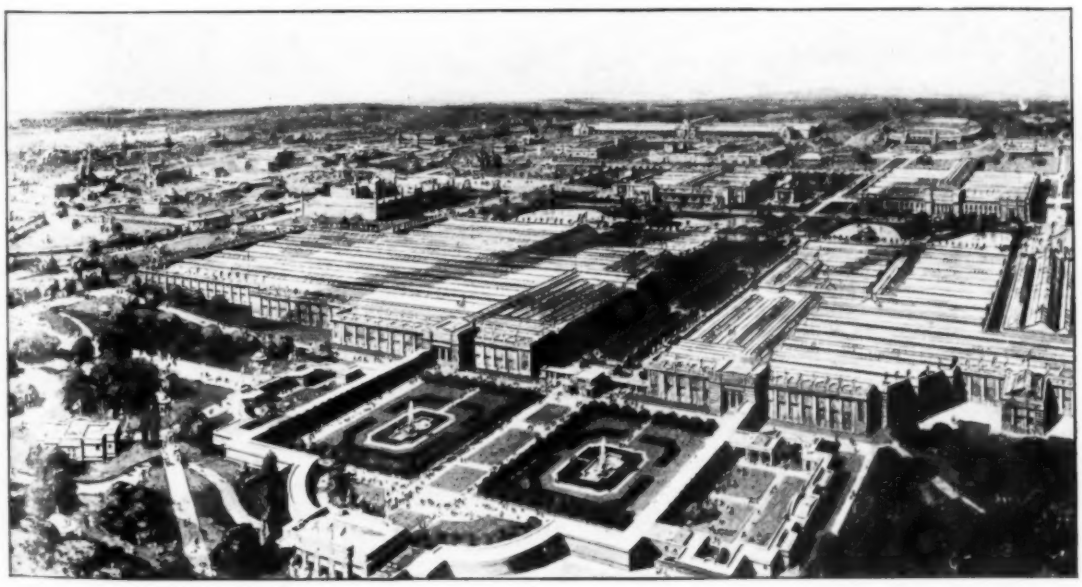
The Palace of Engineering.

With its manifold fascinations which will appeal to and stir the hearts of millions of British subjects at Home and Overseas, we do not need to deal in these pages. If we can succeed between now and the closing day in October next in giving adequate attention to the features that fall legitimately within our province we shall fulfil our best intentions and realise our highest hopes.

Already there have reached these shores a large number of overseas visitors who are interested in the productive capacity of the industries of the United Kingdom. Thousands of others are on their way or will be starting shortly. Every train from the provinces will be bringing our people to their Wembley destination. But in our writing for these pages we have to bear in mind that vast multitudes will be unable to come, and their information will be gained by reading and by hearsay. We hope that electrical and other engineers and buyers will come in numbers because what they read tells them of the things that they must see unless they are going to miss an opportunity such as will probably never recur within their lifetime.

For the past eighteen months we have devoted space ungrudgingly to the electrical engineering aspects of the great event, so that our readers are already familiarised with the general scheme, and during the past two months we have endeavoured to show the representative way in which British manufacturers were taking part, by means of preliminary notices of their exhibits in the Electrical Section of the Palace of Engineering. In the present issue we describe the power station—a collective exhibit in itself—and a few of the larger exhibits of which full particulars and photographs have been available.

Never before have the electrical and engineering manufacturers of Britain entered so whole-heartedly upon any undertaking. Never has there been brought together so vast and so representative an exhibition of their manufactures. Never have they poured out their resources with such liberality. And we believe that the enthusiasm that has marked their unexampled effort is the outcome of two things—one, their confidence that the world influence of the event upon our industries will be immediate, will be enormous, and will continue for years to come; the other their determination to impress



By courtesy of the British Empire Exhibition.

Bird's-Eye View of the Exhibition.

all parts of the British Empire and foreign countries too with the limitless resources, practical and theoretical, industrial and commercial, of British electrical, civil, and mechanical engineering.

In the Electrical and Allied Engineering Section organised by the British Electrical and Allied Manufacturers' Association there are 155 exhibits, some of them comprising the manufactures of several firms.

In the Shipbuilding, Marine, Mechanical and General Engineering Section for which the British Engineers' Association has been responsible, the products of more than 400 manufacturers are exhibited on nearly 300 stands.

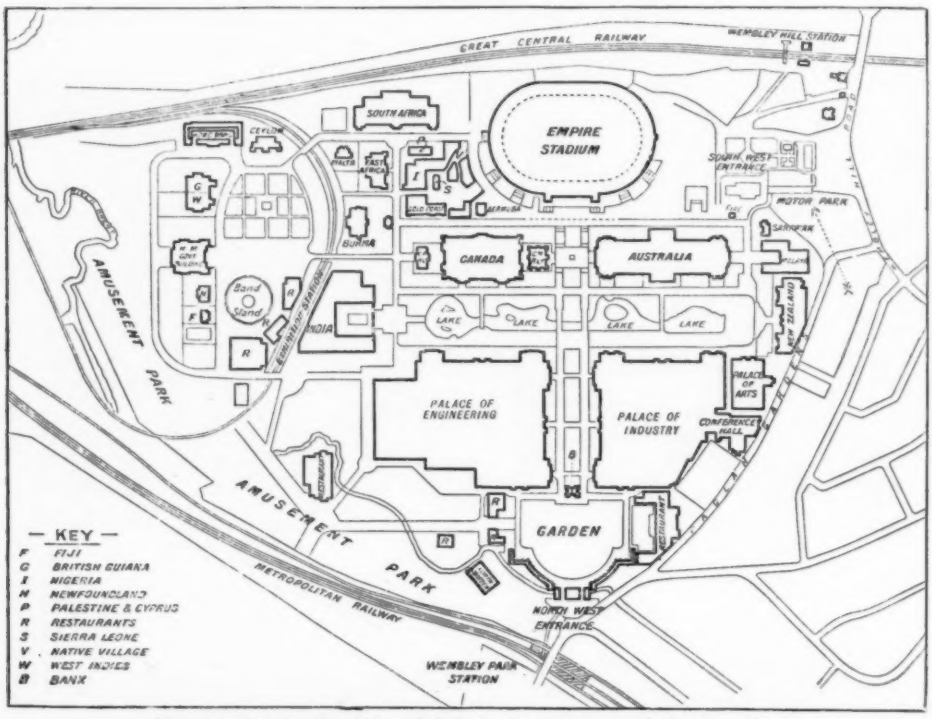
There are no foreign manufactures at Wembley. Everything is British, and the whole of the vast collection of electrical and engineering products—the largest ever brought together—will be as a great magnet drawing to it engineers from all corners of the globe, hundreds of thousands of employés in the great factories at Home, and the rising generation from the colleges and schools of the country. All will, we believe, be impressed as never before with the greatness of the industry and its exceptional fascinations.

By courtesy of the British Empire Exhibition.

Interior View of the Palace of Engineering.

In the Palace of Engineering one of the finest examples of co-operative effort is to be found in the very effective demonstration organised by the Electrical Development Association. Here for the next six months a large staff will be at work day and night demonstrating the uses of electricity for innumerable everyday purposes, to many thousands of people. We shall give a special description of this combined display a little later.

As a whole, the electrical section of the exhibition was very far advanced towards completion on the opening day. Owing to circumstances which are referred to in our article on the lighting installation—in itself an enormous undertaking—a certain amount of work remained to be done, but ample illumination was provided for most purposes. Some complaints have appeared in the lay Press with regard to delay in furnishing a supply of electricity for lighting and power to exhibitors' stands, which has been variously attributed to shortage of power and to an inadequate supply of cable; we understand, however, that neither of these reasons is correct—7,000 kW was available on the opening day, and there was an abundance of material on the spot. The delay was solely due to the impossibility of completing the thousands of electrical connections that were called for during the last few weeks, which overtaxed the physical capabilities of all the skilled labour that could be brought to bear on the job. Any deficiencies of this nature will be quickly made good, and within a week or two the electrical services will be in full working order.



Plan showing the Exhibition Buildings, the Stadium and the Grounds.

The Wembley Electricity Supply.—I.

The Three-Phase A.C. Installation.

In an undertaking of the enormous size and scope of the British Empire Exhibition, it is evident that considerable use will be made of electric light and power. The general supply throughout the grounds and buildings is being furnished by means of a 3-phase, 4-wire distribution network at pressures of 415 volts, 3-phase and 240 volts, single-phase. The sources of supply are three:—

(1) An a.c. steam generating station in the Palace of Engineering, equipped with turbo-alternators.

(2) An a.c. high-pressure transformer sub-station in the Palace of Industry, drawing a supply from the North Metropolitan Electric Power Supply Co.

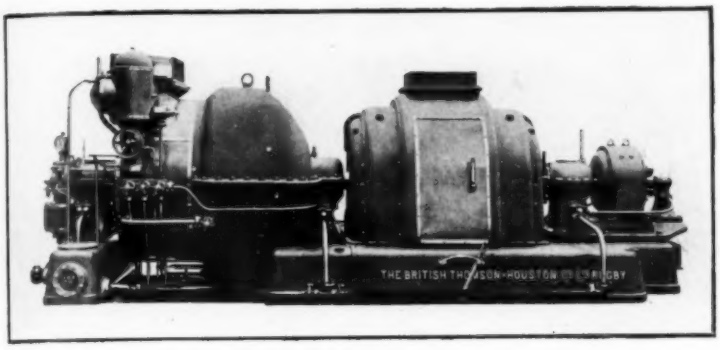


Fig. 1.—B.T.-H. 1,500-kW Turbo-generator.

(3) A d.c. supply furnished by steam-driven reciprocating sets and internal-combustion engines in the Palace of Engineering, operating in conjunction with a rotary sub-station.

The main switchgear (fig. 5) of the Reyrolle com-

(1) and (2) were made through the British Electrical and Allied Manufacturers' Association and the British Engineers' Association, and the plant capacity available is as under:—

(i) Turbo-generator station, 4,500 kW; (ii) North Metropolitan Co.'s sub-station, 2,000 kW; and (iii) d.c. plant, four sets, aggregating 1,000 kW; or a total of 7,500 kW.

The power station (fig. 2) is equipped with three 1,500-kW, 3-phase, 50-cycle, 3,000-r.p.m., 3,300-volt steam turbo-generators, which feed static transformer sub-stations from which the general a.c. supply is derived. The first set (fig. 1) consists of a British Thomson-Houston turbo-generator, with Cole, Marchent and Morley condensing and auxiliary plant; the turbine has seven stages, and is designed for a steam pressure of 200 lb. per sq. in., superheated to 600 deg. F., and it discharges into a vacuum of 28 in. The cooling air is circulated within the casing of the standard 2,000-kVA alternator by the fan action of the rotor. The cooler consists of nests of tubes through which cooling water flows and around which the ventilating air passes. The cooling water is obtained from the condenser circulating system at the rate of 85 gallons per minute and at a temperature not exceeding 75 deg. F. The second set (fig. 3) is of

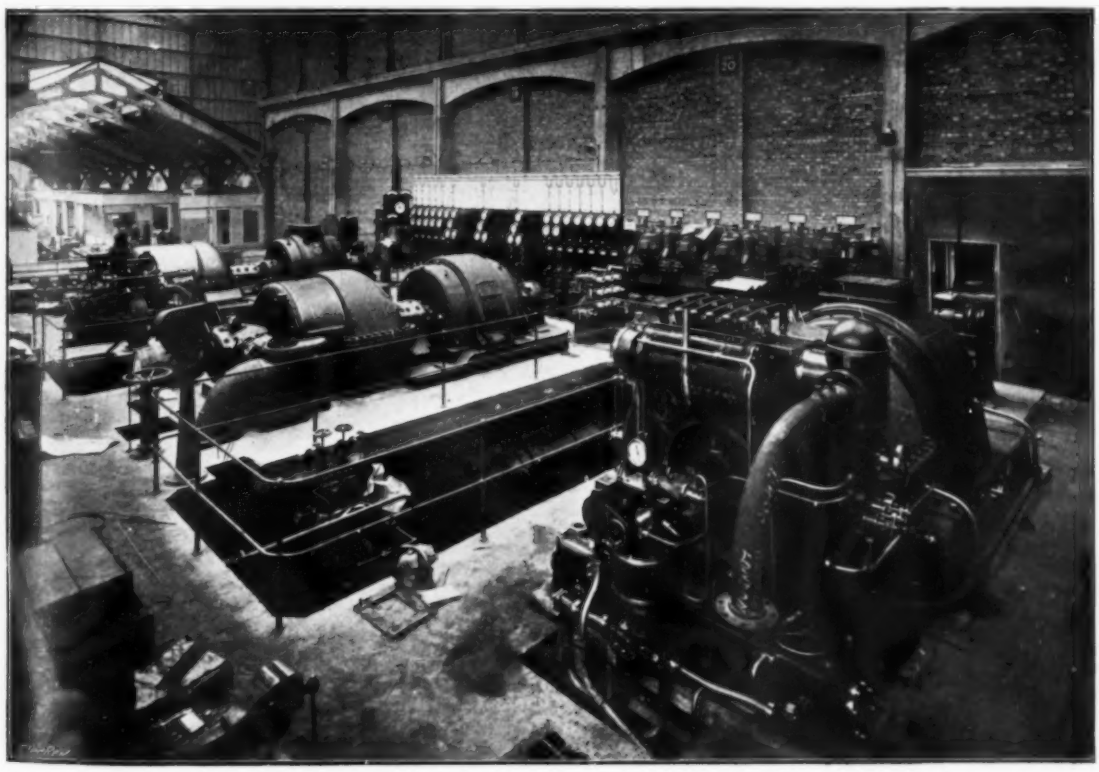


Fig. 2.—The British Empire Exhibition Power Station.

English Electric manufacture throughout; while the third (fig. 4) is made up of a Howden turbine and a General Electric generator, with a Musgrave condenser and auxiliaries (fig. 7).

The main switchgear (fig. 5) is of the Reyrolle com-

pound-filled truck type, and forms 15 panels of remotely-controlled electrically-operated main gear, complete with a master control switchboard (fig. 4), on which is mounted a B.T.-H. Tirrill voltage regulator and is arranged to operate on any one of the three machines. The neutral-earthing equipment comprises three single-phase remotely-controlled Reyrolle pillar-type oil switches that are operated from the master control board; they are arranged to earth the neutral of any one of the three machines through a special Everett Edgcumbe resistance.

A 60-cell, 150-ampere-hour capacity battery has been provided through the Accumulator Makers' Association for operating the switchgear and also for emergency lighting purposes. The charging set consists of a 415-volt, 3-phase, 50-cycle, motor coupled direct to a d.c. generator by Submersible Motors, Ltd., with a G.E.C. control panel.

The condenser cooling-water towers (fig. 8) are of two types; one was supplied by the Davenport Engineering Co., Ltd., and the other by the Premier Cooler and Engineering Co., Ltd. They are of the natural-draught chimney pattern, and each is capable of reducing the temperature of 175,000 gallons per hour from 92 to 75 deg. F.

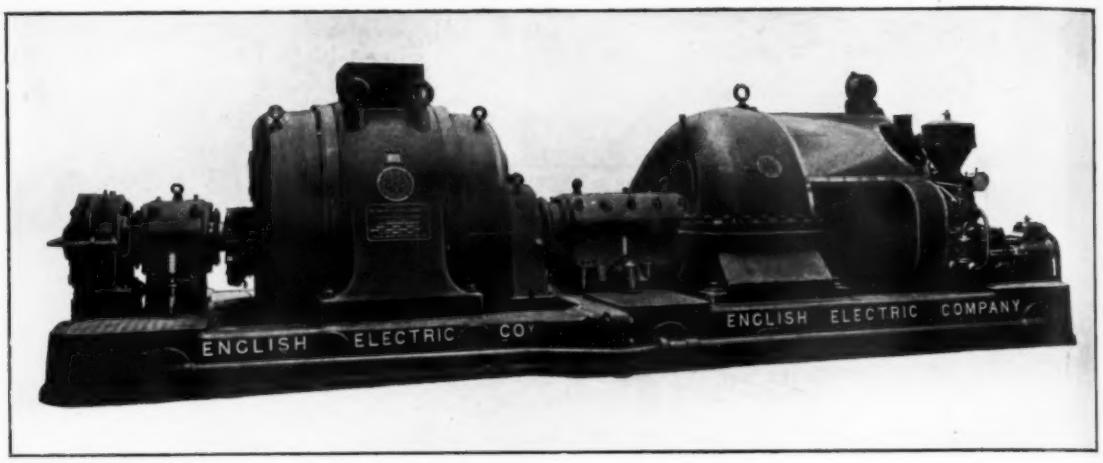


Fig. 3.—English Electric 1,500-kW Turbo-Generator.

The battery of four water-tube boilers (fig. 9) supplies steam, superheated to 600 deg. F., at a pressure of 220 lb. per sq. in. The plant has been generally divided between Messrs. Babcock & Wilcox, Ltd., and Messrs. John Thompson Water-Tube Boilers, Ltd. The two B. & W. land-type boilers are separately set, each having an integral superheater and double chain-grate stokers, which are electrically driven through epicyclic gear. Each boiler has a total heating surface of 6,182 sq. ft., and is capable of normally evaporating 20,000 lb. per hour, or a maximum of 25,000 lb. Lea coal

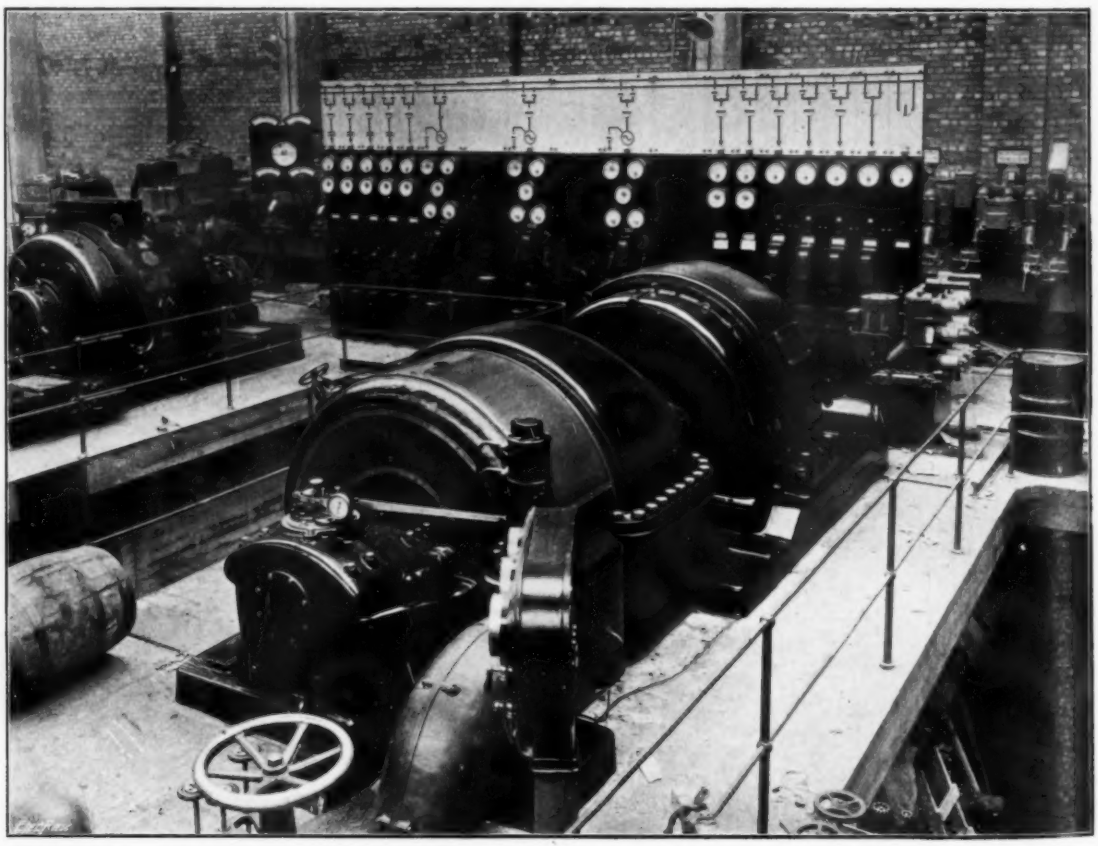


Fig. 4.—Howden-G.E.C. 1,500-kW Turbo-Generator and Main Reyrolle Switchboard.

meters are fitted to each stoker, and each boiler is provided with a complete Green economiser installation arranged in two groups with 96 pipes, and constructed to operate at 220 lb. per sq. in.

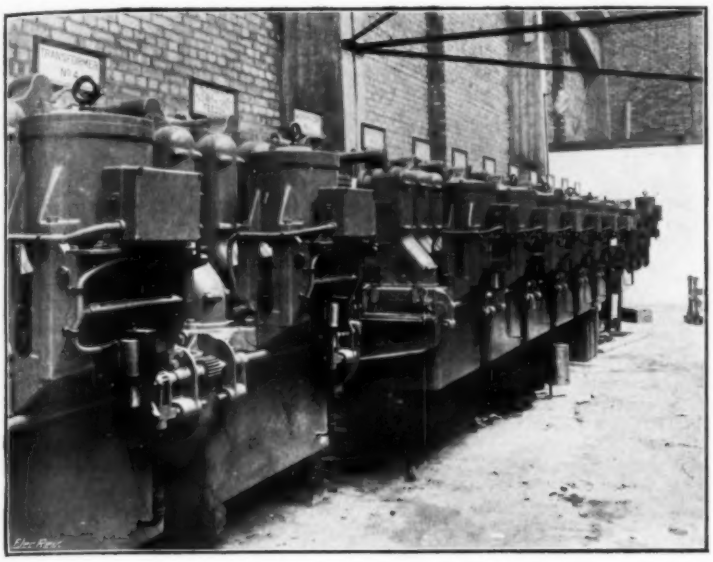


Fig. 5.—Reyrolle 3,300-volt Switchgear.

The Davidson induced-draught plant consists of a 50-in. standard electrically-driven Sirocco fan discharging into a self-supporting steel chimney 6 ft. in diameter and 75 ft. high. One of the boilers is equipped with B. & W. calorised "Diamond" soot blowers of the valve-in-hand type, six blower elements in all being fitted.

The two John Thompson straight, vertical, water-tube boilers are also separately set, and each is equipped with a pair of Thompson electrically-driven mechanical chain-grate stokers. Each boiler has a total heating surface of 4,700 sq. ft., the other details being similar to those mentioned above.

Two Worthington-Simpson feed pumps provide a joint supply of water for the boilers. One is of the "Simplex" vertical, double-acting, steam-driven type capable of delivering 10,000 gallons of water per hour at a speed of 15 double strokes per hour; the other is a 4-stage centrifugal pump capable of delivering 10,000 gallons per hour at 2,800 r.p.m. It is coupled direct to a motor with an oil-immersed star-delta starter by Messrs. Crompton & Co. For boiler feed make-up purposes water is drawn from the mains of the Colne Valley Co. and treated in softening plant, a 3 ft. 6 in. "Permutit" set being supplied by United Water Softeners, Ltd., and a "K"-type outfit by the Kennicott Water Softener Co., each of which is capable of dealing normally with 1,000 gallons per hour.

The coal-handling plant is by the Mitchell Conveyor and Transporter Co., Ltd. An electrically-driven Ransomes & Rapier capstan hauls the wagons to and from the railway sidings and tippler; the latter is arranged to discharge the coal on to an adjoining store, whence it passes by gravity from a hopper on to an underground cross conveyor approximately 52 ft. long. The latter transports the fuel to a second, or main, conveyor approximately 350 ft. long, which feeds an automatic skip hoist that elevates the coal to the bunker level, where it is discharged on to another conveyor arranged with a travelling discharge so as to deposit the fuel at any desired point in the bunkers. A Mitchell continuous automatic weighing machine is embodied in the main conveyor, as well as another by Messrs. S. Denison & Son, Ltd., and

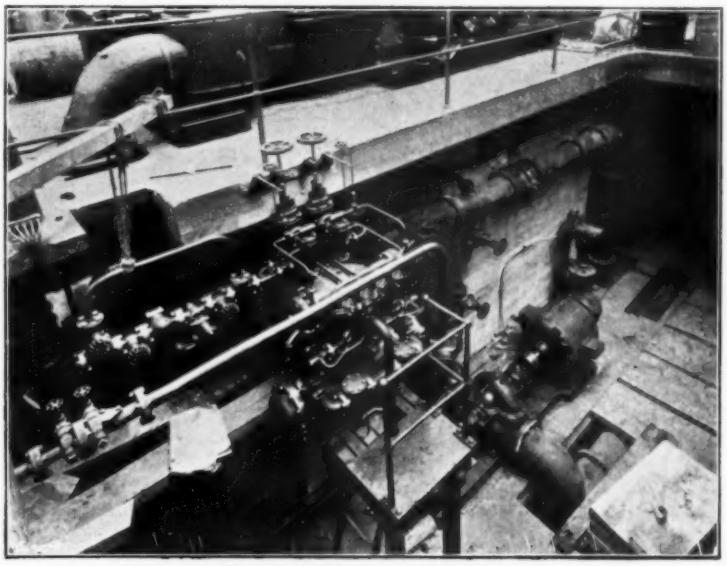


Fig. 7.—Musgrave Condensing Plant.

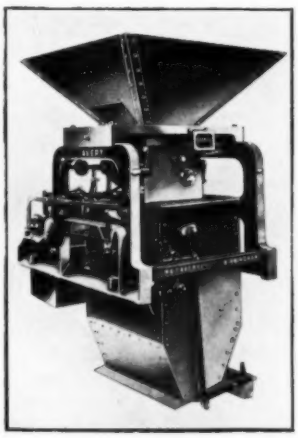


Fig. 6.—Avery Coal Weigher.

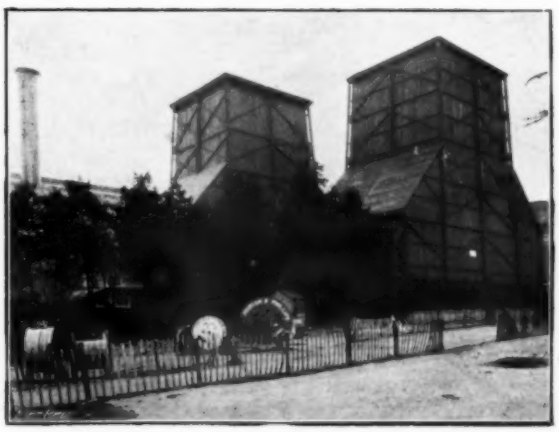


Fig. 8.—Cooling Towers.

arrangements have also been made to weigh the coal separately for each boiler by fitting a 2-cwt. Avery auto-

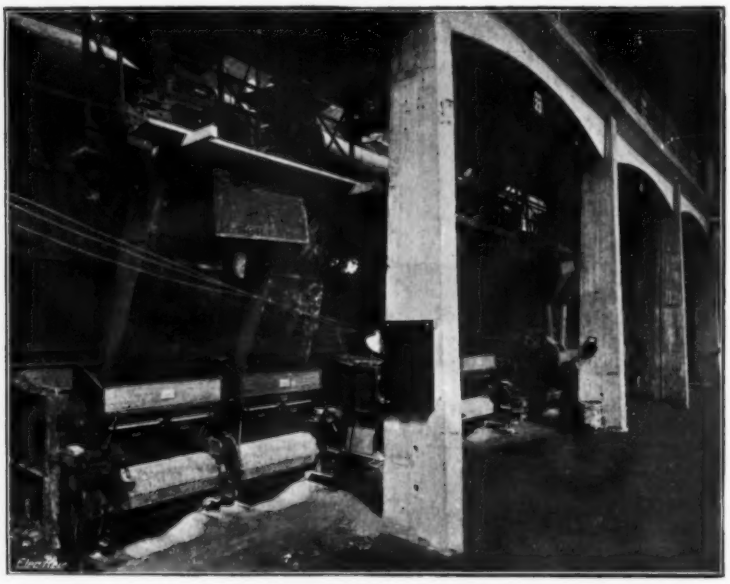


Fig. 9.—The Boiler House.

matic weighing machine immediately under the overhead bunker, and over each of the four boilers, fig. 6. These machines operate on the principle of weighing a predetermined amount of coal at one turn. In this particular case the amount is 1 cwt., and a mechanical counter keeps a record of the number of weighings made, all coal passing to the boiler being accurately weighed within one per cent.

An automatic installation has been supplied by Messrs. Babcock and Wilcox, Ltd., for continuously removing the ashes from all four boilers. The plant is of the water-sealed type, the ash and clinker falling from the furnaces down chutes into tanks containing revolving paddle mechanism (that consists of a low-speed disk set at an angle of about 45 deg. and having vanes

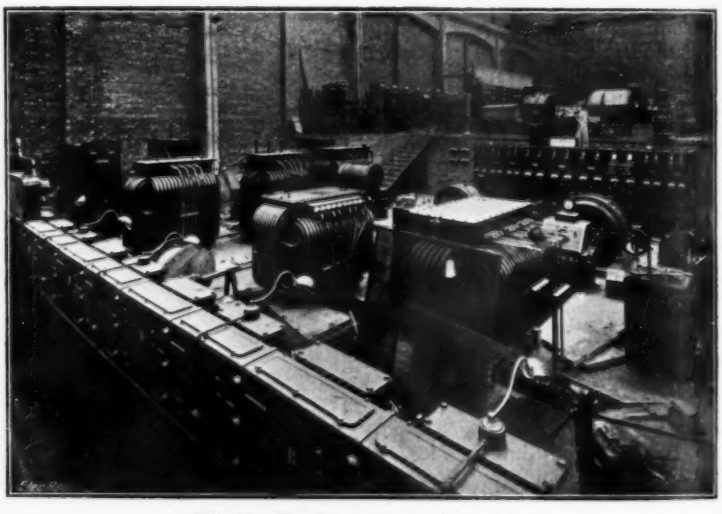


Fig. 11.—The Power House Sub-station.

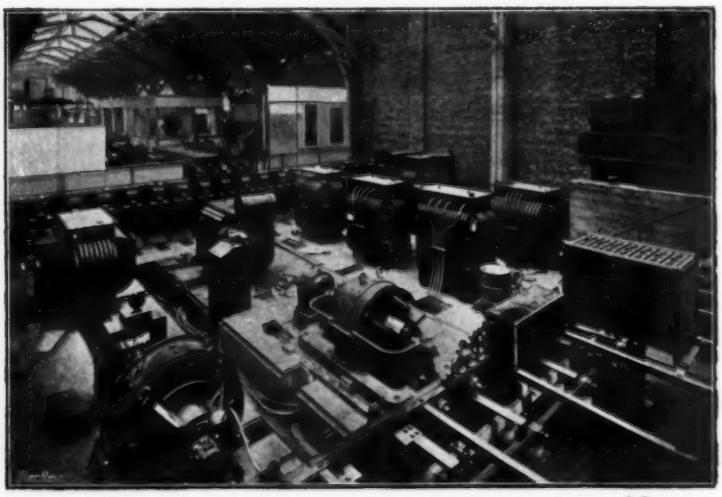


Fig. 10.—The Power House Sub-station.

on its periphery), by means of which the ash is removed from the tanks and deposited on a belt conveyor that discharges it into a bunker outside the building. The advantage claimed for this apparatus is that no working parts, beyond the actual disk, come into contact with the water; the bearings of the disk and conveyor are, therefore, not subject to corrosion and heavy mechanical wear.

The coal chutes feeding the stoker hoppers from the overhead coal bunkers are of the Babcock & Wilcox traversing type, while the motors for the induced-draught fan, economisers, and stokers were supplied by the B.T.-H. Co. With the exception of certain integral piping which was furnished by the boiler makers, the whole piping system was carried out by Messrs. Stewarts & Lloyds, Ltd. The supply of steam, water, and other valves was divided amongst the five following firms:—Messrs. Dewrance & Co., J. Blakeborough and Sons, Ltd., Glenfield and Kennedy, Ltd., Alley & MacLellan, Ltd., and the Clayton Valve Co., Ltd. Measuring instruments, meters, recorders, &c., were furnished by the Lea Recorder Co., Ltd., Messrs. Geo. Kent, Ltd., and the Cambridge & Paul Instrument Co., Ltd., while the whole of the boiler plant and accessories, steam and other piping were inspected by the National Boiler & General Insurance Co.

The two 25-ton, 72 ft. 6 in. span, overhead electric travelling cranes, with motors by Messrs. Electric Motors, Ltd., in the electrical section of the Palace of Engineering, as well as the 10-ton, 47 ft. 6 in. span overhead travelling crane, with B.T.-H. motors, in the power house, were supplied by Messrs. Babcock and Wilcox, Ltd.

The common distribution network which is supplied by the above-described generating plant is also fed by the converting equipment in the main sub-station (figs. 10 & 11) adjacent to the power station, which contains two 500-kW, 3,300/440-V rotary converters supplied by the British Thomson-Houston Co., Ltd., and the English Electric Co., Ltd.

Some of the Exhibits at Wembley.

The British Thomson-Houston Co., Ltd.

(Stand Nos. 19 & 28, Avenues 9-10, Bays 11-15.)

THE capabilities of this well-known company (of Rugby) are well demonstrated in the collection which has been brought together in the Palace of Engineering, ranging from heavy switchgear and machinery to electric lamps and radio equipment.

One of the most striking exhibits is the automatic substation which has been erected on the stand. This comprises

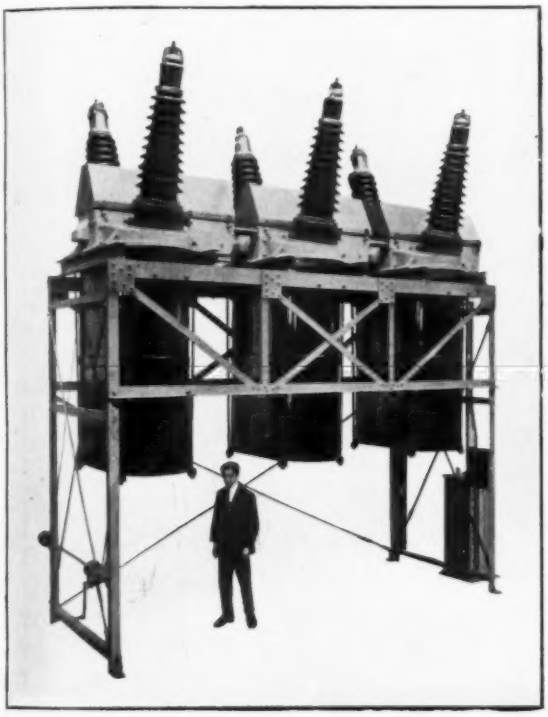


Fig. 1.—B.T.H. 110,000-V, 3-phase Oil Circuit Breaker.

a 500-kW, 550-V, compound-wound rotary converter provided with end-play and over-speed devices, operating from the 3,300-V, 3-phase, 50-cycle supply; h.p. and l.p. switchgear; and automatically reclosing d.c. feeder switches. Two important features of the equipment are an auxiliary generator which is used to ensure the correct polarity of the converter, and a motor-driven master controller, which determines the sequence of switching operations. Full protection is provided against overloads, short-circuits, over-speed, low a.c. voltage, single-phase starting, stalling, overheating of converter, loss of d.c. supply for control circuits, d.c. earth leakage, hot bearings, wrong polarity, overheating of starting motor, d.c. reverse power, and a.c. overload or earth leakage. The station is started up by a master starting element, which energises the master control contactor through a time-delay relay, ensuring that the equipment will not commence working on account of a momentary drop in the d.c. line voltage.

Switchgear occupies a large part of the company's stand. A 110,000-V, 3-phase oil circuit breaker, illustrated in fig. 1, is shown. This is fitted with bushing transformers and a.c. centrifugal operating mechanism, and is designed for outdoor use. The type H25 circuit breaker, which is also exhibited, is designed for 15,000-V service. Two seamless steel oil vessels or "explosion pots" lined with insulating material are provided on each phase, so that each of the two breaks takes place in a separate vessel. Special provision is made to keep

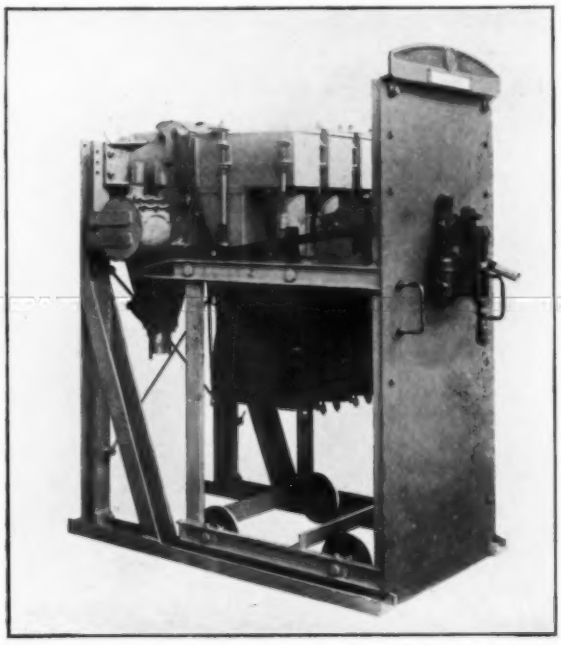


Fig. 2.—Section of Compound-filled Truck-type Gear.

the rupturing arc from the working surfaces. The contacts are separated with maximum acceleration by powerful compression springs. A motor-operated device is provided to follow up the switch and complete the compression of the springs at the end of each stroke. Another exhibit is a 6,600-V oil circuit breaker (fig. 8), in a moulded stone-work cubicle, consisting of three single-pole units coupled together for a three-phase system. Each cell is divided horizontally into two compartments so that the exposed terminals and connections are effectively separated from the chamber containing the oil tanks. Remote control is provided by means of gear of the solenoid type, powerful springs giving a high-speed break from the point at which the contacts separate. These springs also act as buffers, absorbing all shock at the end of the stroke. In conjunction with this cubicle is a

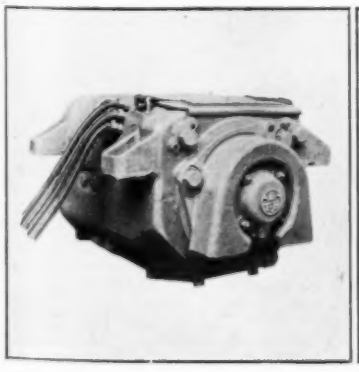


Fig. 3.—B.T.H. Trolley 'bus Motor.

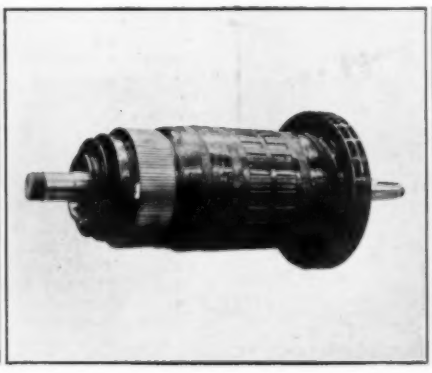


Fig. 4.—Trolley 'bus Motor Armature.

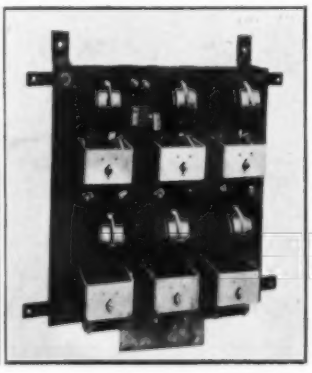


Fig. 5.—Trolley 'bus Contactor Gear.

generator control panel. Four types of protective systems are demonstrated on the stand. These are a circulating-current system for generators and transformers; a balanced-power system for the incoming ends of parallel feeders; a balanced-current system for the outgoing ends of parallel feeders; and an opposed-voltage system for single feeders with pilot wires. These systems are provided with appropriate switch panels with indicating lamps, &c. Among the truck-type gear shown is the R.1 type, which is compound-filled; a view of one section of this appears in fig. 2. This has

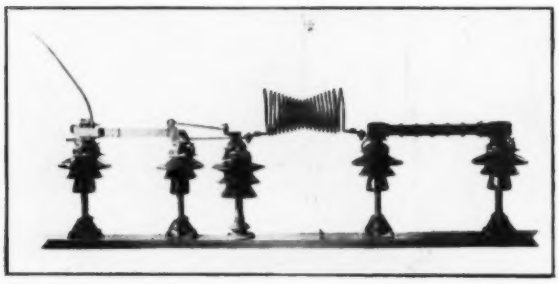


Fig. 6.—Isolating Switch, Choke Coil, and Expulsion Fuse.

a fixed bus-bar portion and a movable truck. The truck unit, after being completely withdrawn from the plug contacts connected to the bus-bars and the circuit respectively, can be handled with perfect safety and removed to any convenient place. The oil circuit breaker has main contacts of the reversed laminated brush type, carried on substantial porcelain insulators. A separate cam lowering and raising device is provided for the circuit-breaker tank. Simple and robust interlocks ensure that all operations are carried out in the correct sequence, and provide efficient protection for the operator. Upon the withdrawal of the truck a shutter automatically covers the fixed contacts.

Among the other switchgear exhibited is the single-pole isolating switch for use on 33,000-V circuits, shown in fig. 6. This is assembled, for horizontal mounting, with a 50-A expulsion-type fuse and choke coil. An alternative type of hinged expulsion fuse for vertical mounting is illustrated in fig. 9. The fuse holder consists of an insulating tube enclosed in a porcelain housing; the two ends of the tube, being provided with cylindrical contacts which fit into the spring contact clips mounted on pin insulators, exert a considerable pressure on the contacts and ensure the maintenance of a good connection. The hingeing of the fuse permits it to be taken out of circuit and left hanging.

In the motor and motor-control section, which occupies a good deal of space, is a 275-h.p. synchronous motor driving a Belliss & Morcom air compressor. The motor is of standard

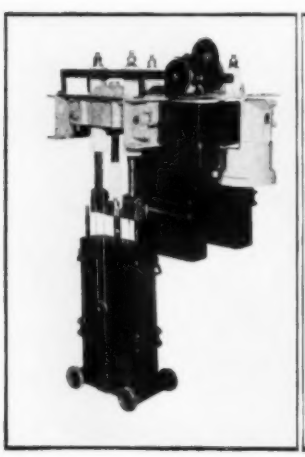


Fig. 8.—Three-phase Oil Circuit Breaker with Oil Tank Lifter and Carriage.

Fig. 9.—Expulsion Type Isolating Switch-fuse.

construction, having a squirrel-cage starting winding embedded in the pole faces; it is capable of starting the unloaded compressor against one-third of the full-load torque. It is controlled by means of a cubicle-type panel in which are mounted a four-pole double-throw oil circuit breaker, an auto-transformer, and the usual motor and exciter field rheostats and switches. Another exhibit is a 400/440-V, 3-phase, 50-cycle machine capable of running at any speed between 1,350 and 350 r.p.m., the brush adjustment being made by a small motor. The output varies from 25 to 8 h.p. Speed control is effected by a contactor-type panel, with push-button control. Compound-wound d.c. motors for crane operation are also shown. The control equipment exhibited includes a 100-h.p. 500/480-V motor-control panel with ammeter and isolating switch; a similar equipment for a 15-h.p. 200/220-V motor; a starting panel for a 25-h.p., 400/440-V, 3-phase slip-ring induction motor; a 50-h.p., 400/440-V, 3-phase auto-transformer starter with low-volt release, overload relays, and ammeter; starting rheostats for d.c. machines, &c. One motor accessory shown is the "Fabroil" silent pinion.

The traction section comprises a large collection of motors and control gear. Some of this is illustrated in figs. 3, 4, and 5, which depict, respectively, a motor for propelling a trolley 'bus, its armature, and the contactor gear for its control. These are installed in a representative 'bus cab. The motor is a 600-V machine rated at 42 h.p., and is shown complete with a pedal-operated contactor control system, consisting of a small foot-operated master-controller, a reversing and braking controller, mounted beneath the driver's seat, and the panel bearing six contactors, shown in fig. 5. These are electrically locked in such a way that no mechanical interlocks are required. The current which the contactors have to carry is so small that all burning of contacts is eliminated. All electric braking is carried out by the controller under the driver's seat and not by the contactors, so that electric braking is still available when there is no power in the line, or if the trolley leaves the wire. Owing to the system of interlocking, all contactors are opened immediately by the first movement of the brake lever. A light-weight ventilated interpole traction motor is shown, and among other train-control gear is the pneumatically-operated con-

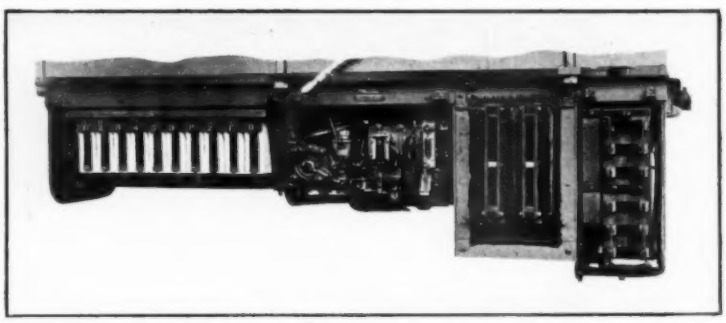


Fig. 7.—B.T.H. Pneumatically-controlled Traction Contactor Gear.

tactor control equipment, for 1,500-V motors on multiple-unit trains, shown in fig. 7. This consists, fundamentally, of a motor controller and a master controller. The former handles directly the current for the motors, while the latter merely governs the operation of the motor controller, and, consequently, does not handle the larger currents necessary in the motor circuit. The scheme of operation is that as each section of resistance is cut out of circuit, an increased current passes through the motor and series coil of a current-limit relay. If this current is sufficient to open the relay contacts the progression of the camshaft is arrested until the current falls to a predetermined value. The line breakers, reverser, and contactors are operated by air pressure controlled by magnet valves. In this section are also shown a motor-driven air compressor and a self-regulating motor-generator set for train lighting. The former is of the centre gear type which has been in successful operation for many years on railways and tramways at Home and abroad. It supplies compressed air for braking, sanding, whistles, &c. The self-regulating motor-generator set gives a substantially constant voltage of 125 for train lighting from a 1,500-V traction supply. As the traction supply is subject to considerable fluctuations in practice, the equipment on the stand is designed for variations between 1,200 and 1,500 V so that practical conditions may be simulated and the remarkable self-regulating properties of the set demonstrated. The railway and tramway motors which are shown are of the self-ventilated type, and embody all the latest improvements, particularly as regards electrical characteristics, insulation, lubrication, and general details of construction.

The radio apparatus shown includes examples of crystal and valve sets of the company's standard patterns, as well as valves, loud speakers, head-'phones, and other accessories and components. The lighting demonstration is very effective, consisting of a number of open cubicles, each of which contains a single lighting unit fitted with a control switch. All kinds of "Mazda" lamps are exhibited, and a cabinet showing the various stages of manufacture appears on the stand. Other lighting fittings present are floodlight projectors, industrial-type reflectors, &c.

In the Automobile Section the company is showing its magnetos for ignition, &c.

The English Electric Co., Ltd.

(Stand No. 14, Avenues 9-10, Bays 20-24.)

THE ENGLISH ELECTRIC COMPANY, LIMITED, of Queen's House, Kingsway, London, has installed in the power house a 1,500-kW turbo-alternator set, with a surface condenser of 2,800 square feet, and in a sub-station a rotary converter of 500-kW, together with a 550-kVA transformer and tap-starting pillar. The most interesting exhibit on the stand is doubtless the "Transverter," with which 3-phase, 3,300-volt, 50-cycle alternating-current is converted to direct current at 100,000 volts. The output is 1,000 kW. This is an entirely new type of electrical machine, which has often been mentioned of late. A three-panel extra-high-pressure switchboard is used for controlling the a.c. supply, and a synchronous motor drives the brushgear. Another exhibit is a rotary converter of 1,000 kW, running at 750 r.p.m., and generating at 440/575-V, d.c., with a tap-starting pillar (fig. 1). Several transformers are shown, namely, one of 625 kVA, 6,600/414-V, 50-cycle, 3-phase (fig. 2), with its tank, shown separately; a mining-type 200-kVA, 3,300/440-V, 50-cycle, 3-phase transformer; a pole-type transformer, and a group of insulators, specimen windings, and other parts. Another exhibit is an asynchronous-synchronous motor for direct coupling to a compressor, giving 170 h.p. at 187 r.p.m., 415-V, 3-phase, 50 cycles, with its exciter; this machine is designed for unity power factor at full load. A selection of standard d.c. and a.c. motors of 5 h.p. and upwards is shown, one of which is illustrated in fig. 3. The switchgear exhibit comprises a truck-type unit for 6,600 volts, a 20,000-V oil switch with electrical operating gear (fig. 4), a 33,000-V oil switch, a 1,500-V d.c. traction circuit breaker, an a.c. low-pressure ironclad distribution board with main oil switch, an auto-transformer ironclad starting unit, a starting unit with oil-immersed rotor starter, and a liquid starter, pot type. The traction exhibit includes a camshaft controller and master controller for an electric locomotive, shown in operation. This type of control is fitted to the numerous locomotives and motor coaches illustrated on the stand. As representing the company's aircraft, the "Wren" 3-h.p. light aeroplane, which tied for first place in the light plane consumption trials at Lympne in October, 1923, with a record of 87.5 miles per gallon, is exhibited by arrangement with the Society of British Aircraft Constructors. "English Electric" motors are driving a wide variety of machines on the stands of other exhibitors; these include loom machinery, boiler-house auxiliaries, refrigerating plant, a compressor at the Model Colliery, &c., &c.

An interesting feature of the exhibit is a 30,000-h.p. hydraulic turbine destined for the Behira power station of the Tata Company. Five sets of this type have been ordered. These turbines are of the twin impulse type, designed for a net head of 1,630 ft., and running at a speed of 375 r.p.m. Each set is fed by two separate pipe lines, fitted with two cylindrical balanced valves, which work with water pressure in a differential servo-motor (fig. 5). A travelling control valve prevents quick closing of the piston. The inlet bend is designed for double regulation on the "Seewer" system which rapidly destroys the energy of the jet by means of

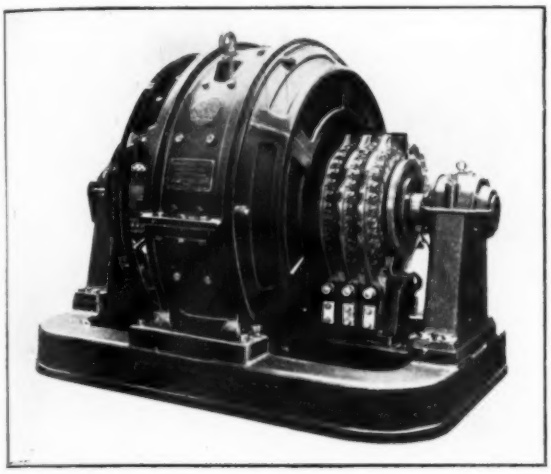


Fig. 1.—"English Electric" Rotary Converter, 1,000 kW, 750 r.p.m., from Slip-ring End.

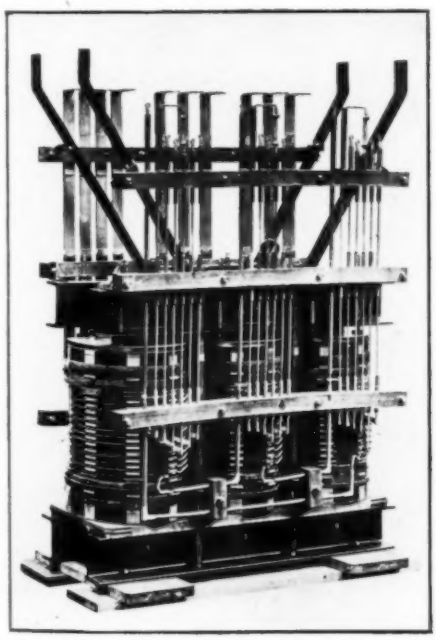


Fig. 2.—"English Electric" Transformer for 625 kVA, 50 Cycles, 3-Phase.

Fig. 3.—Enclosed Ventilated Slip-ring Motor with Flame-proof Slip-ring Cover and Trifurcating Boxes.

Fig. 4.—20,000-V Cell-type Oil-break Switch.

specially designed blades, and closes the spear slowly to prevent undue rise of pressure. Fig. 6 shows the wheel of a similar turbine, running at 300 r.p.m., in which the simplicity of the attachment of the buckets can be seen, consisting of a single bolt and a key. The bolt is conical and fits tightly in a split bush; and every alternate key is machined out of the solid disk.

Both turbines are controlled by one governor, provided with the usual adjustments and an automatic device which shuts down the set if the speed varies 30 per cent. above or below normal. The oil-pressure for the servo-motor is provided by a two-stage rotary pump. The servo-motor controls two regulating shafts which transmit its movement to the "Seewer" diffusers, which in turn control the spear servo-motor, by means of distributing valves; on its way through these valves the oil flows through regulating screws, as in the case of the travelling control valve above-mentioned, the flow being reduced by the increased friction along the thread, which enables a very fine adjustment of the closing time of the spear to be made.

The runner of a 25,000-h.p. hydraulic reaction turbine is also shown, which is being installed at the Sorocaba power station of the Sao Paulo Power Co., Brazil; the turbine is built for a net head of 650 ft., and a speed of 600 r.p.m. The spiral casing is fixed on two extensions of the generator bed-plate, and the turbine cover is connected with the main bearing by two strong bolts, making the thrust bearing practically solid with the cover; this is important in view of the small clearances permissible between the runner and the casing with the high pressure of 20 atmospheres. For the same reason the thrust bearing is situated between the generator and the spiral casing, so that the extension of the generator shaft due to heating shall not affect the clearances. In fig. 7 it will be seen that there are two forged steel rings on the runner, with concentric grooves in their edges, meshing with corresponding teeth on rings fixed to the casing and thus reducing water leakage; the stationary rings are provided with adjusting screws to maintain the correct clearance when the rings are worn.

Owing to the high suction head and the high velocity of the water, special care has been taken to avoid corrosion in the design of the vanes of the runner, which is made of bronze for the same reason. On the suction bend there is an air snifting valve, to prevent undue suction in case of sudden closing of the gate apparatus. The snifting valve, like the relief valve, is controlled by the governor, but can also open by itself; quick closing is prevented by a dashpot. Piping connects the space between the runner and the cover to the suction tube, to equalise the pressure on both sides of the runner.

The spiral casing (which is not exhibited, but is illustrated in fig. 8) has the shape of a logarithmic curve, to give the same entrance velocity of the water all round the gate apparatus. Strong stiffening bolts are used with a continuous thread, so as to strengthen the casing without adding to its stress by the tightening of nuts. Besides fixing the spiral casing securely to the generator bedplate, provision against movement due to the pressure of the water in the pipe-line is made by an erecting joint of special design, with which the pipe-line is fitted just before the sluice valve.

Regulation is effected by a governor and an oil-pressure servo-motor; the governor is very sensitive, and is fitted with double compensation, adjustment of the "permanent speed variation" from 0 to 5 per cent., adjustment of speed by hand and electro-motor, and an automatic safety device coming into action if the speed varies 30 per cent. above or below normal.

The oil-pressure tank is fed by a pump driven by a little impulse wheel, which is provided with automatic control and maintains the pressure between 14 and 16 atmospheres, without wasting power.

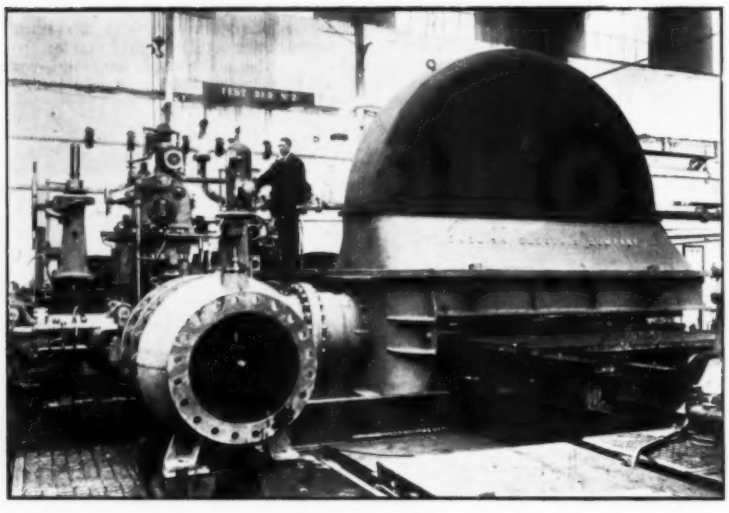


Fig. 5.—"English Electric" 15,000-h.p. Turbine (one-half of 30,000-h.p. set).

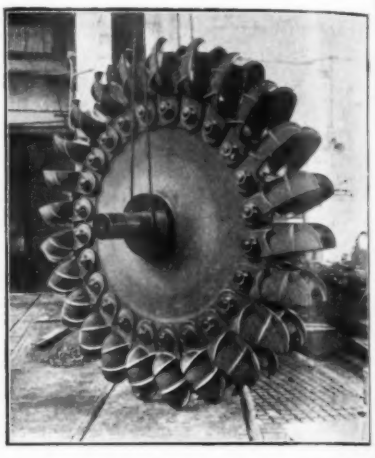


Fig 6.—Runner of 15,000-h.p. Turbine.

Fig. 7.—Runner of 25,000-h.p. Turbine.

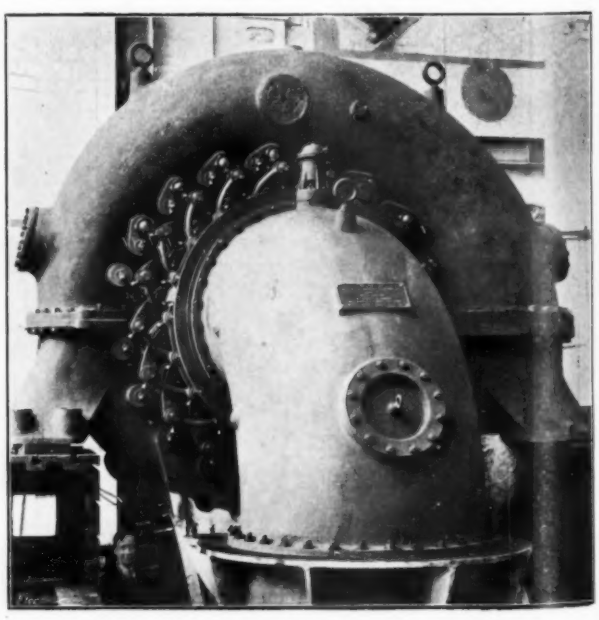


Fig. 8.—25,000-h.p. Turbine for Sorocaba (not exhibited).

The Marconi Companies.

(Stand No. 72, Avenue 11, Bays 9-11.)

THE Marconi stand contains a variety of exhibits representing the latest developments and appliances in all branches of wireless science. The stand is shared by Marconi's Wireless Telegraph Co., Ltd., the Marconi International Marine Communication Co., Ltd., the Marconiphone Co., Ltd., and the Marconi Scientific Instrument Co., Ltd.

The most prominent feature of the stand is the model of a wireless beam transmitter, which is mounted on the roof and rotates slowly as in action. This apparatus represents one of the latest developments in applied radio work, and is intended to enable all classes of coastal shipping fitted with an appropriate receiver, including vessels which do not carry wireless operators, to obtain bearings during fog when in the neighbourhood of dangerous points. As it revolves, it signals to every two points of the compass a different Morse letter. These signals are transmitted on a very short wavelength, and are picked up by special receiving apparatus which is independent of the ship's ordinary wireless installation, and does not require operation by a skilled telegraphist. The receiving instrument is kept permanently tuned, and all that is required to bring it into operation is to switch on the current to the valves. By observing the Morse letters which his instrument receives, the navigator is able to tell the direction of the transmitter, and by taking a succession of readings at intervals he can accurately chart his course.

At the present time one of these projectors is operating on the Island of Inchkeith, in the Firth of Forth, and another is being erected at the South Foreland.

Special receivers for use in connection with the wireless beam transmitter are also shown (fig. 1). These receivers are used in pairs, each being fixed outboard on either side of the ship's bridge.

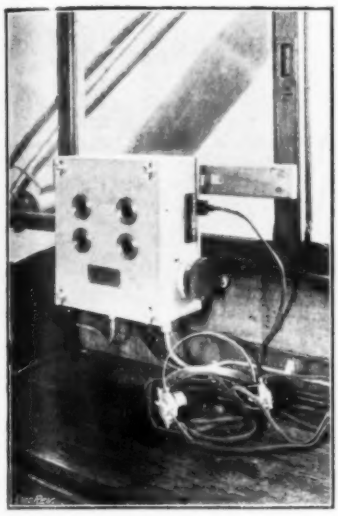
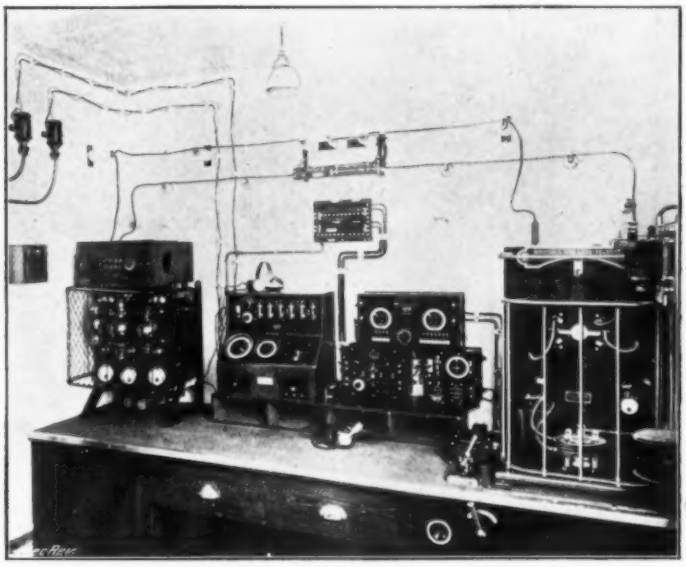


Fig. 1.—Marconi Wireless Beam Receiver.



C.W. Valve Transmitter. Marine Direction Finder. Marine Receiver. Quenched Spark Transmitter.

Fig. 2.—Marconi Standard 1½-kW Ship Installation.

After the beam transmitter, the most striking exhibits are two "valve pillars." The "valve pillar" (fig. 4) is the latest design of electric oscillation generator which has been developed by the Marconi Co. for use in high-power wireless stations, and this is the first occasion upon which it has been exhibited. These pillars constitute power units which can be used collectively for any required power. Each pillar incorporates 16 large-type Marconi transmitting valves, and is capable of dealing with 80 kW; but the power can be regulated in sectional steps of 20 kW according to prevailing conditions.

The Marconi magnetic drum recorder is an instrument operated on a new magnetomechanical principle. It is primarily a recording and relaying instrument for high-speed commercial wireless reception, but it can also be used for

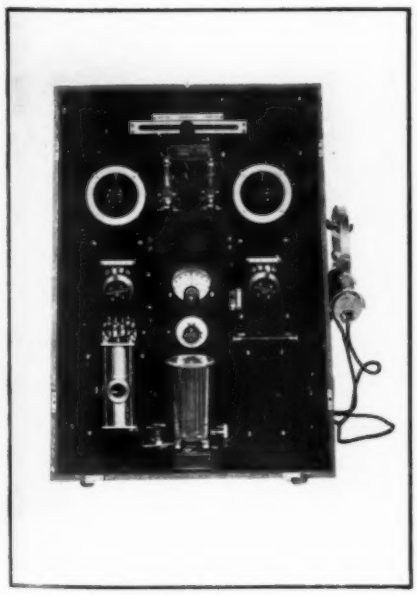


Fig. 3.—Wireless Bell Receiver.

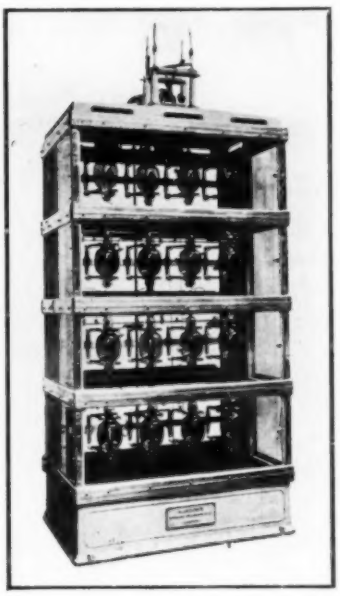


Fig. 4.—Marconi 80-kW Valve Pillar.

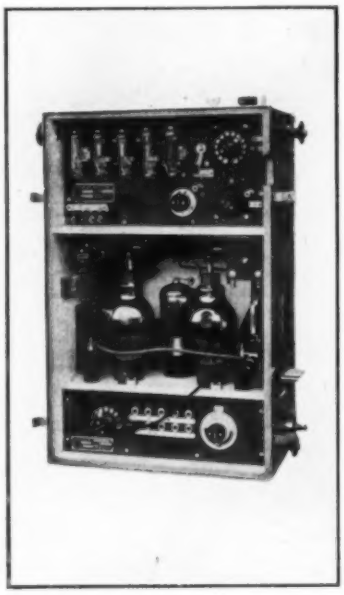


Fig. 5.—Aircraft Apparatus, Type AD6.

recording the time intervals between electric impulses, and can be made to rectify and oscillate and so perform electro-mechanically the same operations that a thermionic valve does electrically. It is said to be extremely robust, and many times more sensitive than any other form of electromagnetic recorder; its performance is unaffected by the rolling of a ship, shocks, or vibrations, and it is therefore especially suitable for use at sea.

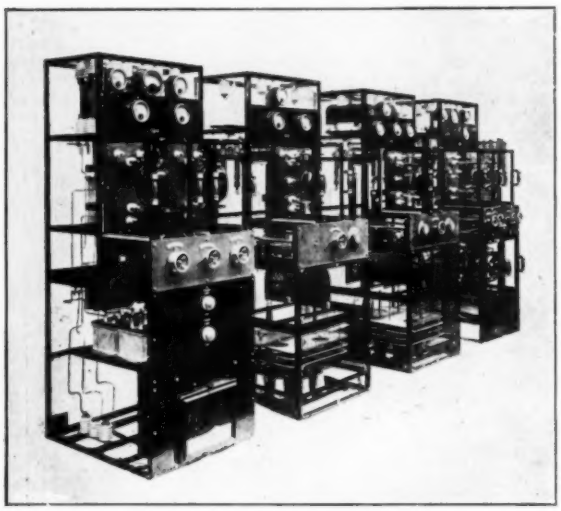


Fig. 6. Marconi 6-kW Broadcasting Transmitter.

Two exhibits of great popular interest are the complete 6-kW standard Marconi broadcasting transmitter (fig. 6), and the Marconi microphone, such as is used in the British broadcasting stations.

An exhibit of special interest is the Marconi wireless bell, fig. 3, which performs the same function as the call bell on the ordinary land-line system, and is principally used in connection with wireless telephone apparatus for communication between lightships and shore stations.

A complete aerodrome ground station is shown, embodying special receiving apparatus, and including provision for aircraft direction-finding; three types of aircraft transmitters and receivers as fitted to aeroplanes on the principal air routes (fig. 5); and a new direction-finder for installation on aeroplanes, to enable the pilot to obtain his bearings direct.

Field sets include a portable transmitter and receiver with masts and aerials, and a mule pack unit on saddle frames, for military use and for other purposes in the field.

The exhibits of the Marconi International Marine Communication Co., Ltd., are arranged in three ships' cabins. The first cabin contains spark and continuous-wave equipment as installed in the wireless cabin of a large ship, and comprises the following:—Main spark transmitting apparatus complete (1½ kW, quenched spark); continuous-wave transmitting apparatus (1½ kW); marine receiver, No. 1; emergency apparatus; and direction finder (fig. 2).

The new Marconi wireless installation for ships' lifeboats is shown for the first time. This set has been specially designed with a view to the fact that it will be used under the most adverse weather conditions and in a very confined space. The transmitter is capable of attracting the attention of a ship using a crystal detector at a distance of 50 miles, and the receiver has directional properties, so that the lifeboat crew can ascertain the bearing of any ship which may be coming to their rescue, and inform her which way to steer.

The Marconiphone Co.'s exhibits include examples of broadcasting receiving sets, and the Marconi Scientific Instrument Co., which specialises in highly efficient broadcast receivers, is showing some of its beautifully designed *cabinet de luxe* models, as well as high-speed telegraph and scientific instruments and wireless accesscries.

The Metropolitan-Vickers Electrical Co., Ltd.

(Stand Nos. 20 & 27, Avenues 8-10, Bays 7-11.)

As illustrations of the greater part of this company's exhibits are not yet available, we are unable to deal at present with more than a portion of the display—the transformer and switchgear sections. The former comprises several types of transformers, including weatherproof transformers for pole mounting, and oil-immersed patterns for outdoor employment.

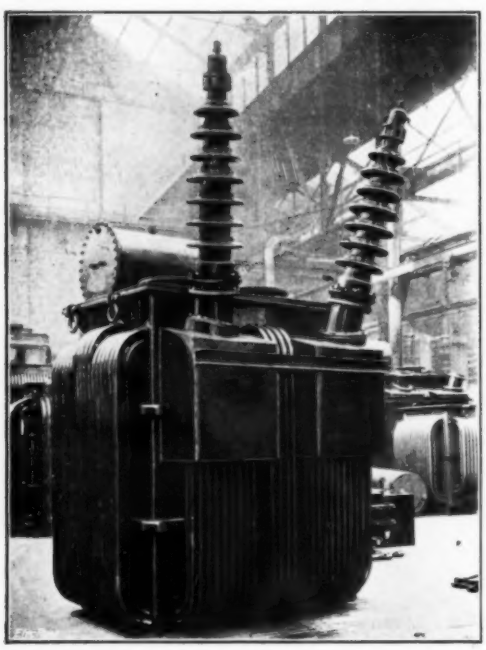


Fig. 1.—A Metropolitan-Vickers E.H.P. Transformer.

The high-pressure side of a number of these transformers is wound for from 110,000 to 133,000 V. One of the transformers exhibited is illustrated in fig. 1.

The switchgear exhibit is a very comprehensive one, and demonstrates well the capabilities of the company. The *pièce de résistance* is a large outdoor type oil circuit breaker for 116,000-V operation. This measures approximately 11½ ft. in height, 17½ ft. in width, and 6½ ft. in depth. It is electrically operated. A "Type K.7" circuit breaker is also shown. This is electrically operated and rated for 2,400 A at 11,000 V. The height of this piece of apparatus is 19 ft., and it is 9 ft. wide and 5 ft. deep. A further circuit breaker shown is that illustrated in fig. 2. This is the "K.5" type of ironclad

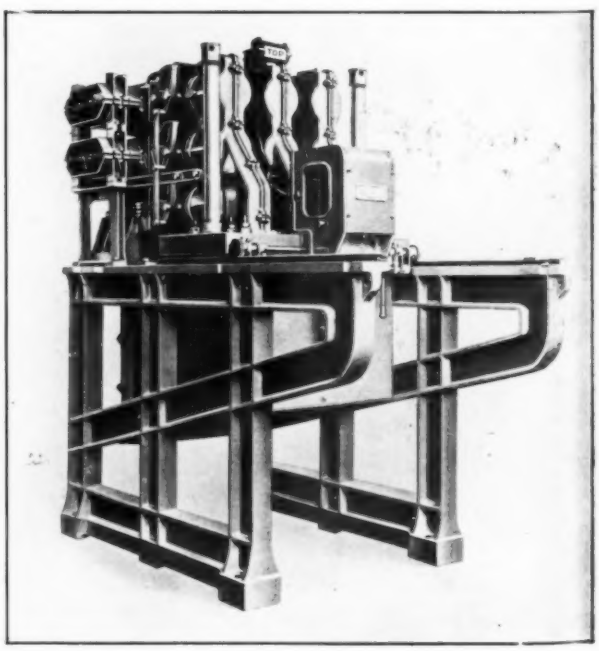


Fig. 2.—A 35,000-V Ironclad Draw-out Circuit Breaker.

construction with a draw-out arrangement, and is equipped with current and potential transformers. All these large circuit breakers are arranged so that their mechanical action can be demonstrated by means of push-button controls. Other switchgear shown includes outdoor designs with air breaks for high pressures, fitted with lightning arresters.

The Foster Instrument Co.

(*Stand No.* 123, *Avenue* 14, *Bay* 16.)

This firm has a collection of thermometers, pyrometers, electrical instruments, &c. Among the thermometers is the electrical resistance type for use at a distance. This is self-compensating for changes in battery voltage, and thus obviates the use of a rheostat and "test point" adjustments. The pyrometers include the disappearing filament pattern, a total radiation fixed focus type, and a special "power plant" pyrometer specially adapted for measuring the temperature of superheated steam, &c. The indicator employed is constructed to withstand vibration. The firm has a set of instruments in action connected to the power station. An industrial pyrometer installation is shown. This provides a continuous automatic record of furnace temperature, with lamp signalling, and automatic furnace control applicable to electric and gas furnaces and other heating processes. The display also includes a number of portable and switchboard measuring instruments for current and voltage.

Messrs. Worthington-Simpson, Ltd.

(*Stand No.* 69, *Avenue* 11, *Bay* 5.)

Pumps of various patterns form the principal part of this exhibit. The largest is a steam-driven water-raising pump with a capacity of 350,000,000 gallons of water per day. The vertical simplex double-acting piston-pattern boiler feed pumps shown range from one capable of supplying 23,000 gallons per hour to one with a capacity of 940 gallons per hour. These pumps are designed for working pressures of 300 lb. per sq. in., and are provided with the Worthington simplex marine steam valve gear. Pumps for fuel oil are also exhibited; these are of both vertical and horizontal types. There are, in addition, a horizontal double-acting feed pump and a double-acting piston-pattern pump, the latter being arranged for oil circulating in connection with steam turbines. A complete surface-condensing plant for a power station is another important exhibit. This is equipped with steam air ejectors and centrifugal circulating and extraction pumps.

The British Lighting and Ignition Co., Ltd.

(*Motor & Cycle Section, Exhibits Nos.* 2 *&* 14.)

One of the main exhibits on this company's stand is a magneto which is claimed to be the only British-built machine of its type with a stationary armature and revolving field magnet. This form of construction enables the armature to be designed purely as an electrical component ensuring increased efficiency. The contact breaker, moreover, similarly to the armature, is not affected by centrifugal force, and on this account is less likely to give trouble. The exhibit also includes coil ignition sets for use in connection with large gas engines, and magnetos for similar service. In addition there are lighting sets for automobiles, trains, aeroplanes, &c.

The London Electric Firm.

(*Stand No.* 109, *Avenue* 14, *Bays* 5 *&* 6.)

Upon this stand is a special projector for use in the Suez Canal designed to give long-period burning and complete steadiness. The lamp has a horizontal positive carbon and the negative carbon is fixed at an angle to it. The positive is continuously rotated by a small motor of special construction. The arc is struck automatically and is fed by hand at periods shown by an illuminated indicator. The mirror is of the Parsons patent split type now invariably used in the Canal. A projector for use in kinema studios is shown. This also has a rotating positive carbon and yields a light of high actinic value. The special features of this apparatus are a device for giving either a focused or "flood" beam, and an extensible tripod stand with a winch for raising or lowering the lamp body. A pilot house projector is shown in operation. This is arranged for installation outside a chart-house with a "pump-handle" control extending into the structure. The set supplying energy to this consists of a dynamo of the firm's own design, giving 40 A at from 80 to 90 V, driven by an a.c. motor by Messrs. Howells & Co. Other types of projectors are exhibited as well as small winches, flexible couplings, lamp-lowering gear, &c.

British Arca Regulators, Ltd.

(*Shipbuilding, &c., Section, Stand No.* 222, *Avenue* 1, *Bays* 12 *&* 13.)

Relays for the control of high and low pressures, vacua, air temperature, humidity, the temperature of liquids, &c., are shown by this company. A hydraulic cylinder with a pilot valve is connected to an "Arca" steam-regulating valve, and another cylinder is connected to a butterfly valve. Any one of the relays can be caused to operate one or other of the cylinders, or a compact type of valve which is also shown, enabling a practical demonstruction to be given of almost any possible arrangement for automatic regulation. An arrangement of the system to control the temperature of de-superheated steam is also exhibited. This consists of thermo-relay operating valves of the compact type admitting water to a series of sprays fitted in a steam pipe. Other arrangements are also shown. This system can be adapted for electrical operation by the use of solenoids to actuate the hydraulic pressure cylinder. In this way current or pressure can be regulated.

Electrical Utilities, Ltd.

(*Stand No.* 66, *Avenue* 11, *Bay* 4.)

Small heating and cooking apparatus constitutes the main part of this exhibit. Among this are several dual-purpose appliances as, for instance, the "Utility" cooker-radiator which can be used, horizontally, for boiling or grilling and, vertically, as an electric fire. It is produced in a number of sizes, ranging from 750 to 4,000 W. The toaster-fire which is also shown has similar characteristics. An oven of light but strong construction is supplied with the cooker-radiator. Some simple types of electric fires are on view. These are of various finishes, designs, and loadings. Another portion of the stand is devoted to current-limiting apparatus. The "Utility" current limiter depends for its effect upon an iron core floating in mercury which is drawn up into a series coil when a predetermined current limit is exceeded; this gives rise to a "pumping" action which can only be stopped by the removal of part of the load. This limiter is also combined with fuses to serve a double purpose; it can be made up in "duplex" to serve lighting and heating circuits; and it can also be used as a relay. Another exhibit is an ignition controller which, when permanently connected to the sparking system of an internal combustion engine, indicates at sight whether the ignition of any cylinder is imperfect, whether the magnet is in good condition, or if any portion of the circuit is faulty.

Messrs. Lacy-Hulbert & Co., Ltd.

(*Shipbuilding, &c., Section, Stand No.* 69, *Avenue* 4, *Bays* 25 *&* 26.)

Blowing and compressing machinery is displayed on this stand. Portable petrol-engine driven air compressor sets are shown, as well as fixed high-speed sets with capacities ranging from 1 to 150 cb. ft. of free air per minute. These machines are mounted on ball bearings and are suitable for direct-coupling to electric motors or petrol engines. The portable electric tire inflator shown embodies a small ball-bearing compressor geared to a .5-h.p. electric motor and is suitable for pressures up to 120 lb. per sq. in. Other compressors and vacuum pumps exhibited are a patent horizontal opposed type, vertical single- and double-cylinder patterns, water and air cooled, and double-acting vertical types. In addition to these there is a range of rotary pumps suitable for circulating and pumping water, suds, brine, petrol, oil, &c., made in gunmetal or cast-iron. Accessories of various kinds are also exhibited.

The Turbine Furnace Co., Ltd.

(*Shipbuilding, &c., Section, Stand No.* 122, *Avenue* 4, *Bay* 28.)

This company shows examples of its patent furnace applied to boilers of different types. The grate area of the furnace is sub-divided into a number of "units," each comprising a separate and distinct "furnace" in itself, complete with fire bars, air injector, and steam jet. The air trough is of diminishing cross-sectional area and ensures an even pressure under the fire bars and along the whole length of the grate. The fire therefore burns evenly with an absence of "dead" patches and "blow-holes." The firebars, which project forward into the stream of air forced along the trough intercept and deflect the air through the fire with a maximum efficiency and a minimum of resistance. Thus all classes of fuel can be burned economically and efficiently.

The Anglo-Swedish Electric Welding Co., Ltd.

(*Shipbuilding, &c., Section, Stand No.* 271, *S.E. Block, Bay* 25.)

This company has the exclusive rights for Great Britain of the Kjellberg arc welding system, and its exhibits are connected with this. A large number of welded test pieces are shown after subjection to tensile, impact, torsional, bending, alternating stress, and modulus of elasticity tests. Photomicrographs are also exhibited in great variety. The principal exhibit is a model of the "Hawthorn-Wyber" boiler, which is said to be the only large boiler so far constructed with welded instead of riveted joints. In this boiler there was a total length of about 500 ft. of welding, and this was carried out so successfully that the boiler withstood a test pressure of 360 lb. per sq. in.—double the working pressure—without further touching up. The boiler has now been under steam for some years, and has never given any trouble.

The Ioco Rubber and Waterproofing Co., Ltd.

(*Stand No.* 77, *Avenues* 11 *&* 12, *Bays* 20 *&* 21.)

On one of the B.E.A.M.A. stands this company displays numerous examples of its insulating materials. Among these are samples of "Linapex" empire cloth and tape which combine the necessary mechanical and electrical properties with flexibility and resistance to atmospheric effects. Synthetic gum resin in varnish form for the impregnation of coils, &c., is shown, and in this connection there are several kinds of tubes and sheets impregnated with the varnish for use in transformer construction. A number of applications of the firm's "Formapex" insulating papers are exhibited, including wrapped bars, switchgear insulating tubes, and a section of a condenser terminal showing the embedded layers of tinfoil. Another application of this synthetic resin insulation is the "Formapex" moulding powder. This powder, compressed in a suitably-heated die, gives polished and intricate mouldings of high dielectric strength.

Broadcasting the King's Speech.

AT the ceremony of opening the Exhibition on Wednesday last week His Majesty King George V delivered a speech which was made audible not only to the vast concourse in the Stadium, but also to hundreds of thousands of listeners throughout the British Isles—thanks to the thermionic valve. The Western Electric Co.'s "Public Address System" was employed for the first-named purpose; it comprises three main sections—the transmitter, the amplifier, and the "receiver projector." The transmitters were suspended from the roof of the Royal Pavilion, and from them the weak speech currents were led through shielded leads to the amplifiers in the control room, which was situated beneath the dais from which the King spoke. The amplifier currents were led to seven projectors arranged in the roof of the pavilion.

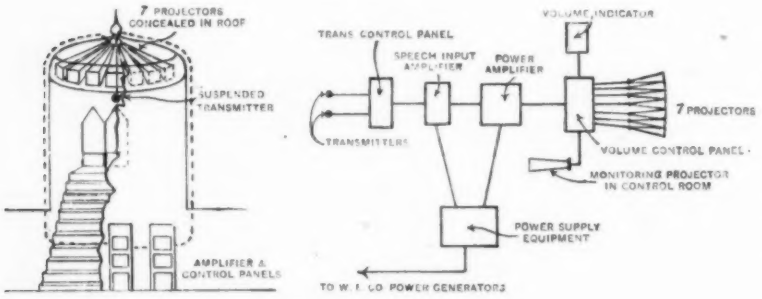


Fig. 1.—Arrangement of Apparatus.

The accompanying diagram shows that the output of the transmitters was taken to a switching panel, where means were provided for cutting in the various transmitters. From this panel the transmitter currents were taken to the transmitter amplifier, which amplified them to a power level suitable for input to the power amplifier. The output from the power amplifier was taken through a panel where switches and a multi-step auto-transformer were provided for the regulation of several projector circuits. Above this panel was a volume indicator to register the volume output to the projectors.

A transmitter which is to reproduce frequencies of the order of 6,000 per second must have a natural undamped period of about the corresponding order, and then damping should be applied until the system has no natural period at all. These conditions make it quite impossible to produce a transmitter that is able to give out more than a very small quantity of electrical speech power.

The transmitter which was used at Wembley consists of a heavy steel ring supporting a tightly-stretched Duralumin diaphragm, less than two mils thick. On each side of the diaphragm is a small chamber containing carbon of special quality. This arrangement enables the asymmetric distortion, inherent in carbon transmitters, to be eliminated by a process of neutralisation. On one side of the diaphragm a flat plate, with suitable perforations, is arranged close to the diaphragm, in order to obtain high air damping. To guard the transmitter against vibration it is suspended by means of spiral springs inside a wire cage housing. The power output from the transmitter, when the speaker is 5 ft. away, is about 10⁻⁴ watt.

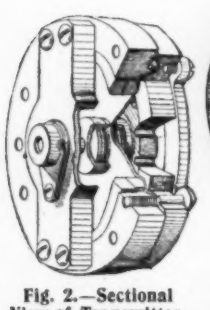


Fig. 2.—Sectional View of Transmitter.

Fig. 3.—W. E. Transmitter Suspended in its Mounting.

The amplifiers used in the system installed at Wembley were of the No. 8-A and No. 10-A types, mounted in panels on two vertical iron racks. The No. 8-A speech input amplifier is a three-valve three-stage apparatus, having two potentiometers to provide adjustment of the gain over a large range. The filaments of the vacuum tubes are supplied from a 12-volt storage battery, while the plate circuits are fed with 350 volts d.c. Proper grid potentials are obtained by utilising the drop over a resistance in the filament circuits of the first two tubes, and for the third tube small dry cells furnish the grid potential. The No. 8-A amplifier is able to deliver speech currents at a maximum power of 0.3 watt.

The No. 10-A amplifier is a 4-vacuum tube apparatus supplying one stage of amplification, the tubes being connected in a parallel "push-pull" system. The grid potential is chosen to permit the largest variation of circuit without distortion. The 10-A amplifier is required to increase the power output to 40 watts, sufficient to give good speech in 14 million ordinary telephone receivers.

The equipment required to give the operator control of the volume delivered by each projector or group of projectors was mounted on a panel uniform with the others, and consisted essentially of an auto-transformer connected across the output of the amplifier with 11 taps multiplied to the contacts of eight dial switches. Seven of the dials controlled projector circuits on each of which one or more projectors could be grouped, and the eighth dial was reserved for controlling the operator's monitoring projector in the control room. A key was associated with each dial for opening the circuit, and a master key was provided for cutting off all the projectors simultaneously.

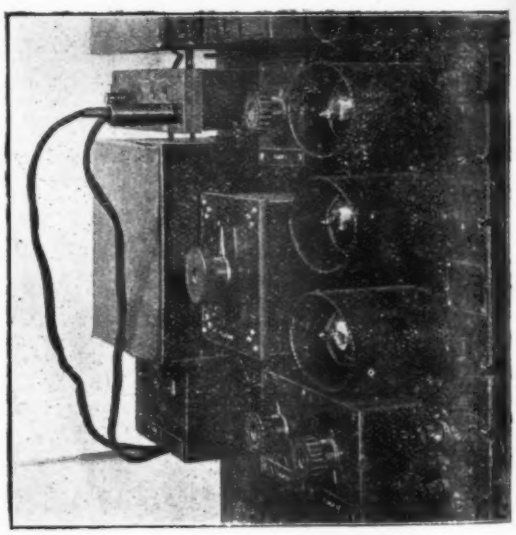


Fig. 4.—No. 8A Speech Input Amplifier.

The volume indicator consisted of a vacuum-tube detector bridged across the output terminals of the power amplifier. The rectified current was taken to a sensitive d.c. meter of the moving-coil type, the deflection of this meter measuring the output from the power amplifier.

Each of the projectors consisted of a loud-speaking receiver and a distributing horn. The receiver was designed to carry several watts without distortion and operated on the balanced-armature principle. A light iron armature, spring-supported, is mounted between the poles of a permanent magnet, and passes through the centre of the coils which carry the voice currents. One end of the armature is attached to a light connecting link which is fixed to the centre of an impregnated cloth diaphragm. This diaphragm is corrugated to permit vibrations of large amplitude. The receiver is provided with a metal cover and a cast-iron case for protection. At Wembley a tapering wooden horn was used, 10½ ft. long, having a rectangular cross-section, the sides being braced to prevent lateral vibrations.

The apparatus used for broadcasting the speeches and music to the vast audience in the Stadium was designed, made, and

installed by the Western Electric Co., Ltd., no apparatus of any other manufacture being used for this purpose.

In order that those who were beyond the Wembley Stadium should hear the King and the Prince of Wales speak, the Western Electric Co. arranged with the British Broadcasting Co. to tap off a circuit from the power amplifier in the control room beneath the Royal Pavilion. This circuit led through a transformer, and was connected to either a landline or the modulator circuit of a short-wave radio transmitting set, for transmission to the London broadcasting station.

Exide batteries were used for broadcasting the King's speech. Thirty 48-volt "A. Y. G. 1" accumulators, in conjunction with "P. W."-type low-pressure batteries, were employed.

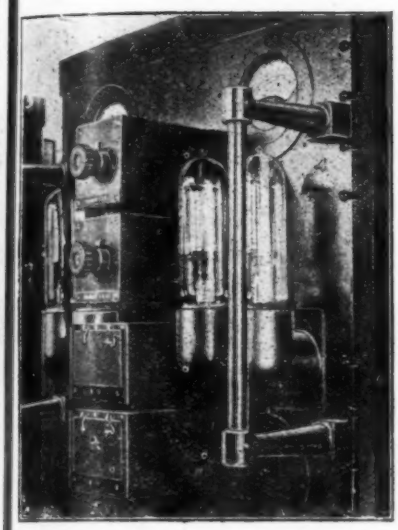


Fig. 5.—No. 10-A Power Amplifier.

Fig. 6.—Horn.

The B.B.C. had put forth every effort to ensure, as far as was humanly possible, that the King's speech should be efficiently broadcast from all its stations throughout the country, and it is gratifying to record that the work of the engineers was wholly successful. The transmission was exceptionally good, and not only the speeches of the King and the Prince of Wales, but also the music and applause were heard with the greatest clearness. Certainly the occasion proved a triumph for all who were concerned in the installation and operation of the "public address system" and the broadcasting service, from start to finish. Hearty congratulations are due also to the veteran scientist, Dr. J. A. Fleming, whose invention of the thermionic valve made the whole thing possible.

Our Personal Column.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Indian Engineering says it is understood that the Government of India have appointed Mr. H. M. MITRA, M.A. (Cal.), B.Sc. (Birm.), to be Electrical Inspector of Mines in India. "Mr. Mitra obtained his B.Sc. degree of the Calcutta University in 1902 and his M.A. in Mathematics in 1903. In 1907 he went to England for higher scientific training, and returned to India in 1910 with the degree of B.Sc. in Electrical Engineering from the University of Birmingham."

Mr. C. F. MACKNESS, M.I.E.E., who has been for the last ten years on the staff of Messrs. Vickers, Ltd., London, in charge of the Electrical Sales Department, and until recently chief engineer of the Hydro-Electric Department of that company, has resigned as from February 29th last. His present business address is 37, Norfolk Street, Strand, W.C.2. Telephone number: "Central 1091."

The marriage took place on April 23rd, at Otford, Kent, of Mr. DOUGLAS FREDERICK SEE, youngest son of Mr. J. W. See, and partner in the firm of J. W. See & Sons, electricians, of Maidstone, and Miss JOYCE HORNER, of Otford.

Mr. JOHN F. COLQUHOUN, of the Glasgow Corporation Lighting Department, who, as already announced, is taking up an appointment under the Sheffield Corporation, has received parting gifts from the members of the Glasgow Lighting Association and others.

Mr. FRANK PICK, for some time joint assistant managing director of the Metropolitan District, London Electric, City and South London and Central London Railway Companies and the London General Omnibus Co., has in the recent reorganisation of these undertakings assumed full administrative control, under Lord Ashfield, states *Modern Transport*.

Messrs. A. S. BLACKMAN and C. H. YEAMAN were to give evidence as representatives of the Municipal Electrical Association on April 29th before the Royal Commission on Mining Subsidence.

Mr. NORMAN B. HILL, of Devonport, has sailed for South Africa to take up the post of senior lecturer in electrical engineering at the Cape Technical College at Cape Town. Mr. Hill received his first training in Devonport Dockyard, which he entered in 1909 as an electrical fitter apprentice, and during the succeeding four years he was twice awarded the Admiralty prize. In 1914 he obtained a Whitworth scholarship and also qualified for a Royal scholarship, thereby being enabled to continue his studies at the City and Guilds (Engineering) College, South Kensington. Later he joined the electrical staff of Messrs. Vickers, Sheffield, subsequently being transferred to the Metropolitan-Vickers Electrical Co., Ltd., Manchester, where he has been closely associated with the mechanical and electrical design of turbine-driven alternators.

Mr. FREDERICK DOWNES, who has for the last eleven years held the position of chief telegraph engineer and superintendent of the Great Northern Railway, has been appointed to a similar position for the whole group of the southern area of the London & North-Eastern Railway. Mr. Downes entered the service of the Great Northern Railway Co. in the telegraph department in June, 1887. In 1903 he was appointed to the post of technical inspector, and in 1912 promoted to be assistant to the telegraph superintendent, and in 1913 he succeeded Mr. T. Ireland as telegraph superintendent. He was awarded the Rosebery Medals in 1903 and 1904 for the best essays on "Railway Electrification" and "Railway Signalling." He is an associate member of the Institution of Electrical Engineers, a member of the Council of the Railway Signalling Engineers, and for the year 1922 was president of the Railway Electrical Engineers and Telegraph Superintendents' Conference.

The Department of Overseas Trade announces in the *Board of Trade Journal* that Mr. S. W. B. MCGREGOR has resigned his appointment as H.M. Senior Trade Commissioner in Australia, and that he has been succeeded by Mr. R. W. DALTON, H.M. Senior Trade Commissioner in Canada and Newfoundland. Electrical men will remember the excellent service that Mr. Dalton rendered during his lengthened stay in New Zealand as H.M. Trade Commissioner from 1915 onwards. In that capacity he visited Australia in the absence of the Trade Commissioner, but a little more than a year ago he was appointed Senior Commissioner in Canada. Mr. Dalton, who is at present in Canada, is expected to leave Vancouver for Australia on May 7th. We believe that our friends in Australia will give Mr. Dalton a worthy reception and that he will be able to bring his special knowledge of the British electrical and allied industries to the assistance of our traders out there in a very marked manner. The vacancy created by Mr. Dalton's transfer to Australia has been filled by the promotion of Mr. F. W. FIELD, H.M. Trade Commissioner at Toronto, to the post of Senior Trade Commissioner in Canada.

According to the *Daily Telegraph* the following appointments and promotions in the Post Office have been made:—Engineering Department.—Mr. H. A. McInnes, Executive Engineer (Provinces), to Assistant Staff Engineer (London); Mr. P. T. Wood, Executive Engineer (London), to Assistant Staff Engineer (London); Mr. T. H. Edgerton, Assistant Engineer (London) to Executive Engineer (London); Mr. H. W. Giles, Assistant Engineer (London), to Executive Engineer (Provinces); Mr. H. Macpherson, Assistant Engineer (Provinces), to Executive Engineer (Provinces).

Congratulations both to the Association, and to Mr. ADAM GOWANS WHYTE, B.Sc., A.I.E.E., personally on the latter's acceptance of an appointment in connection with the publicity and propaganda work of the National Unionist Association. He will be succeeded on the Electrical Press, Ltd., by Mr. Wilfrid L. Randell, who acted as editor-in-chief during Mr. Whyte's illness last year.

Obituary.—MR. JOHN BAGGULEY.—The death took place on April 16th of Mr. John Bagguley, head of the firm of John Bagguley & Son, electricians, of Newcastle, Staffs. He had been in business in the town since 1880. He will be succeeded by his son, Mr. H. C. Bagguley.

New Companies Registered.

British Electric and General Insulators, Ltd. (197,340).—Private company. Registered April 16th. Capital, £1,000 in £1 shares. To carry on the business of manufacturers, importers and exporters of and dealers in all kinds of insulating materials and compounds, electrical and general engineers, paint and varnish manufacturers, manufacturing chemists, &c. The subscribers (each with one share) are: R. J. Jones, 27, St. Mark's Crescent, Regent's Park, N.W.1, accountant; Winifred N. Holliday, 26, The Waldrons, Croydon, bookkeeper. The subscribers are to appoint the first directors. Qualification, £100. Remuneration as fixed by the company. Solicitor: T. B. Kitson, 1, Charing Cross, S.W.1. Registered office: Clare House, Kingsway, W.C.

Electrical and Allied Instrument Manufacturing Co., Ltd. (197,327).—Private company. Registered April 16th. Capital, £250 in 84 "A" and 166 "B" shares of £1 each. To enter into an agreement for the acquisition of the wireless apparatus business carried on by S. F. Hosken, R. H. Dixon and C. L. Dixon at Cowley Works, Cowley Lane, Leytonstone, and to carry on the business of manufacturers, importers and exporters of and dealers in all kinds of instruments and accessories, electricians, mechanical engineers, manufacturers of and dealers in electrical, X-ray and other apparatus, instruments and accessories for medical, surgical, telephonic, telegraphic, wireless and scientific purposes, &c. The first directors are: S. T. Hosken, 153, Fleet Street, E.C.; R. H. Dixon, address not stated; C. L. Dixon, address not stated; S. R. Macdonald, Broyle, Knights Park, Kingston-on-Thames. Qualification: 1 share. Remuneration: £50 each per annum.

H. T. Wilson, Ltd. (197,436).—Private company. Registered April 23rd. Capital, £1,000 in 900 preference shares of £1 each and 2,000 ordinary shares of 1s. each. To carry on the business of general sheet metal workers and dealers, and particularly specialising in electric signs and other advertising devices, &c. The first directors are:—H. T. Wilson, 131, Colegrave Road, Stratford, E.15, manufacturer; R. J. Boning, 19, Minster Road, N.W.2, accountant. Qualification, 1 share. Registered office: 400, Old Ford Road, E.

Gilbert Productions, Ltd. (197,345).—Private company. Registered April 16th. Capital, £3,000 in £1 shares. To acquire the business now carried on at Perseverance Works, King's Road, Hay Mills, Birmingham, as the "Gilbert Engineering Co.," and to carry on the business of electricians, electrical and mechanical engineers, founders in iron, brass and other metals, &c. The permanent directors are:—N. W. Gilbert, Aucklands, Lapworth, Warwickshire (managing director of Berkeley & Young, Ltd.); A. E. Jabet, 39, Reddings Lane, Hall Green, Birmingham (director of Berkeley & Young, Ltd.). Solicitors: J. H. Kitchen, 33, Paradise Street, Birmingham. Registered office: Perseverance Works, King's Road, Hay Mills, Birmingham.

The Electric Light and Power Contracts Finance Corporation, Ltd. (197,344).—Registered as a "public" company on April 16th, with a nominal capital of £10,000 in 19,000 8 per cent. preference shares of 10s. and 10,000 founders' shares of 1s. The objects are: To promote financially and industrially assist the exploitation and development of electrical industries; to establish and carry on in Great Britain, Ireland, and elsewhere the generation and supply of electric light, electric power and traction and gas in all its branches; to carry on business as contractors, electrical engineers, &c. The first directors are:—Sir Charles Buckworth-Herne-Soame, Bt., Sheen Cottage, Coalbrookdale, Salop; W. Thompson, 21, Dennington Park Road, N.16, solicitor; W. H. Mann, 5, Parkgate Road, Watford, contractor; E. C. Bink, 15, Alleyn Park, S.E., engineer. Minimum cash subscription: 100 shares. Qualification, 100 shares. Remuneration (except managing director), £100 each per annum (chairman, £150). Secretary: E. Newman. Solicitor: W. Thompson, 43, Cannon Street, E.C.4. The registered office is at County Chambers, Corporation Street, Birmingham.

Payne & Hornsby, Ltd. (97,444).—Private company. Registered April 23rd. Capital, £5,000 in £1 shares. To take over the business of radio engineers and wireless assemblers and merchants carried on by T. Payne and G. Hornsby at 6, St Andrew's Buildings, Gallowgate, Newcastle-on-Tyne; at 66, Camden Street, North Shields; at the Grand Electric Buildings, Ocean Road, and Russell Street, South Shields; and at Roker Avenue, Sunderland, as "Payne & Hornsby." The permanent directors are:—T. Payne, 24, Hood Street, Morpeth, merchant; G. Hornsby, 30, Osborne Avenue, South Shields, merchant. Qualification, £200. Remuneration as fixed by the company. Registered office: 6, St. Andrew's Buildings, Gallowgate, Newcastle-on-Tyne.

Electro-Mechanical Supplies, Ltd. (197,243).—Private company. Registered April 12th. Capital, £3,000 in £1 shares. To carry on the business of factors, manufacturers, licensors and licensees of electrical materials, appliances, tools and apparatus of all kinds, including in the term "electrical apparatus" for all purposes for which electrical energy and phenomena can be employed, &c. The first directors are:—H. B. Jackson, Styvechale Avenue, Coventry, engineer; J. H. Noble, Earlsdon Avenue, Coventry, engineer. Secretary and solicitor: F. A. Bullock, 35, Bayley Lane, Coventry. Registered office: King William Street, Coventry.

Official Returns of Electrical Companies.

Simmonds & Stokes, Ltd.—Particulars filed of £7,000 debentures authorised April 1st, 1924, charged on the company's undertaking and property, present and future, including uncalled capital, the whole amount being now issued.

C. J. Thursfield & Co., Ltd.—Second mortgage debenture dated April 3rd, 1924, to secure £500, ranking *pari passu* with an existing debenture for £1,500 charged on the company's undertaking and property, present and future, including uncalled and unpaid capital. Holder: R. C. C. Jamie, 106, Trafalgar Road, Moseley, Birmingham.

B. Barnett (Electrical Engineers, Leyton), Ltd.—Debenture dated April 15th, 1924, to secure £400, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: C. G. Cotton, 110, High Street, Whitechapel, E.1.

Light o' Day Electric Lamp Co., Ltd.—Two debentures both dated March 20th, 1924, to secure £250 each, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: Mrs. H. Garside, Hollington Lodge, Hollington, St. Leonards-on-Sea.

Harris and Russell, Ltd.—Floating debenture dated April 1st, 1924, to secure £300, charged on the company's property, present and future, including uncalled capital. Holder: Mrs. B. Harris, 53, Sherriff Road, West Hampstead, N.W.6.

Orford Electric Light and Power Co., Ltd.—Issue on March 19th, 1924, of £200 debentures, part of a series already registered.

City Notes.

South Wales Electric Power Distribution Co.

The annual general meeting was held at Cardiff, on April 28th, under the chairmanship of Mr. W. F. Brown. In moving the adoption of the report and accounts (*vide* ELECTRICAL REVIEW, April 25th, p. 669), the chairman referred to the company's extensions of plant. He said that a new 15,000-kW set had been in commercial use since January, carrying about 10,000 kW. The high-pressure boilers necessary to enable the set to give its full output were in course of installation. A second, similar, set was under construction together with the necessary auxiliary plant, and the extension of buildings to accommodate this plant was well in hand. The demand for energy continued to increase, and the company had about 65,000 h.p. of motors connected to its system. Arrangements had been concluded for a supply to the Great Western Railway Co., at the Barry Docks, and inquiries for power were being received from a number of actual and prospective works and collieries in the district. Contracts had been placed for additional mains.

The company had decided to supply at a frequency of 50 cycles where possible, and at present this would have to be done by means of converting plant. The installation of 50-cycle generating plant in the Treforest station was, however, under consideration. This policy would enable the company to take over, in due course, many of the supplies now being given by isolated 50-cycle stations as well as other large loads. The question of the development of the Western part of the company's area was also receiving attention. These developments would necessitate the raising of new capital; this matter would be dealt with in such a way that no undue financial burden would fall upon the company in anticipation of its ability to meet it.

The arrangements for carrying through the exchange of stock and shares for those of the limited company were proceeding as quickly as possible.

Canadian Companies.

Montreal Light, Heat and Power Consolidated.—Quarterly dividend of $1¼ per share on the common shares, payable May 15th.

Kaministiquia Power Co., Ltd.—Quarterly dividend of $1 per share on common shares, payable May 15th.

Northern Ontario Light and Power Co., Ltd.—The net profit for 1923 was $475,430; to this was added $546,639 brought forward, making $1,022,069. After paying preferred dividend $239,000 is transferred to reserve and $568,617 carried forward.

Southern Canada Power Co., Ltd.—Dividend of $1 per share, payable May 15th.

Clayton and Shuttleworth, Ltd.

The report for 1923 records an adverse balance of £40,249. This is set against £42,445 brought forward, leaving a profit balance of £2,196, which is to be carried forward.

A contract has been entered into with Messrs. Babcock and Wilcox, Ltd., by which, in consideration of the payment of £250,000, this firm will acquire the Clayton boiler works, foundries, and engine works. The directors state that owing to the loss of trade in the Russian, Rumanian, Argentine, and other markets, the company has sustained serious financial loss. The average amount of the company's standard trade in all markets during the last three years has been only 6 per cent. of the pre-war volume. The future policy of the company will be to preserve the nucleus of the standard trade in readiness for a revival of demand, for which adequate facilities are retained; to develop the production of finished motor-car parts; and to take all steps possible to preserve the value of the investment in Clayton Wagons, Ltd. The proposals are to be submitted for confirmation at an extraordinary general meeting which will follow the annual meeting on May 5th.

Prospectus.

Ferguson, Pailin, Ltd.—The subscription list opened last Friday, and is to close to-day (if not earlier) in an issue of 32,219 7 per cent. cumulative participating preference shares of £1 each at par, and 41,109 ordinary shares of £1 each at £1 3s. per share. An abbreviated prospectus appeared in our last issue (p. 40, Advt. Supplement), giving particulars of the dividends for the past five years and of the anticipated profits. The prospects of development of the home trade and the vast electrical developments that are now taking place in the Colonies are referred to, and the new facilities that have been progressively provided in the way of production works and in organisation have brought results for the past two years which form strong evidence of the stability of the company, achieved during a period of unparalleled depression. Now that the worst has been left behind the directors look forward to a period of steady development.

Babcock and Wilcox, Ltd.

The net profit for 1923 was £753,064, plus £194,126 brought forward. The interim dividend on the ordinary shares was 5 per cent., and it is now proposed to pay a further 5 per cent. and a bonus of 2 per cent., both free of tax. £153,750 is to be put to reserve, £55,000 to dividend equalisation fund, £20,000 to staff pension fund, and £187,767 is to be carried forward. The works are able to cope with the demand for the construction of boilers for extra high pressure, and they are reasonably well supplied with orders. Business generally in 1923 was very exacting; the position still prevails, but it has improved in 1924, compared with last year, "but the menace to a continuance of increased activity lies in the fact that requests for increased rates of wages in the engineering trades are being put forward." The works in Australia are operating continuously, and have ample orders in hand. The works in Japan were very little damaged by the earthquake, and have a good deal of work to carry out in connection with the re-construction of the destroyed cities.

Indo-European Telegraph Co., Ltd.

Mr. H. L. M. Tritton presided at the annual meeting on April 24th, and in presenting the report and (1922) accounts (*vide* our last issue, p. 669), referred to the death of Mr. J. H. Tritton, the late chairman. He said that by the re-opening of the company's international through route it had resumed its active existence after an interruption of nine years. The concessions from the British, German, Polish, Russian, and Persian Governments were all settled on a stable basis; in the case of Germany the company was working under a preliminary concession, terminating at the beginning of next year. Active negotiations were proceeding, and it was hoped that an extension of the concession to 1954 would soon be received. After referring to the aid received by the company from the Cis-Indian Joint Purse, the chairman said that the cost of reconstruction would ultimately amount to £200,000. This was a heavy item which had to be liquidated before the end of the company's concessions, and it would be necessary not only to add to the reserves and to apply them to this object, but to adopt a very conservative policy generally. Speaking of the reconstruction of the line, the chairman said that in 1922 most of the line in Poland had been rebuilt. During 1923 efforts had been concentrated on the line in Russia. Owing to the energy of the company's chief engineer and his staff, with the help of the Russian Government, the line was brought to such a state of efficiency that it was possible to carry traffic in a satisfactory manner during the winter months. Further expenditure would be necessary from year to year to bring the line into such a state of perfection that former customers and new ones would be attracted to the system. The company had two wires from the United Kingdom to Teheran, and the German Government had placed a third line at the company's disposal, which was being used primarily for Continental traffic. The Manchester station had been re-opened, and now both that city and Liverpool had the benefit of communication to the East by direct working *via* London. In conclusion, the chairman referred to the company's exhibit in the Indian Section of the British Empire Exhibition, where, he said, messages would be dealt with both to and from India.

River Plate Electricity Co., Ltd.

The report for 1923 states that the net revenue was £71,388, and to this was added £9,680 brought forward, making £81,068. After the payment of interest on debenture stock there is a balance of £73,069. From this the preference dividends are to be paid, £25,000 is to be contributed to general reserve, a dividend of 8 per cent. is to be paid on the ordinary stock, and £11,307 carried forward. The report states that the formalities in connection with the transfer of the assets of the German company to the Spanish company were completed during 1923, and that the contract between the company and the Cia. Hispano Americana de Electricidad has now become effective. Serious competition is threatened by the proposed construction of a power station by the Government of the Province of Buenos Aires. Accompanying the report is a circular letter to shareholders notifying them of the signing of an agreement whereby the Cia. Hispano Americana de Electricidad purchases the company's undertakings at La Plata and Ensenada for £200,000. This sum, it is stated, is substantially in excess of the net cost. The agreement will be put forward for confirmation at to-day's annual general meeting.

Western Union Telegraph Co., Ltd.

The report for the year ended December 31st, 1923, states that improvements and additions to the property during the year increased its book value by $13,416,407, the largest amount ever added in any one year. Noteworthy improvements were made by the replacement of heavily-loaded aerial lines in congested centres with underground conduits and cables; the substitution of copper wire for iron wire; and the installation and extension of pneumatic tube systems for conveying messages between main and branch offices. The net operating return from land line operation was, for the year 1923, 6.7 per cent. of the book value of the land line property; the average for the past ten years was 5.9 per cent. Transatlantic cable rates were reduced about 20 per cent. in April, 1923, but in spite of this, cable system revenues for 1923 declined less than 10 per cent., as compared with 1922.

All seven Western Union transatlantic cables have now been equipped with the recently developed apparatus for direct working between American and European termini. A two-conductor cable was laid between Valentia, Ireland, and Sennen Cove, near Penzance, England. The cable stations at Canso, N.S., and Duxbury, Mass., were refitted and modernised. Twelve dwellings were erected at Canso, N.S., for the accommodation of employés. A new cable ship, "Cyrus Field," is being built by the Société des Chantier et Ateliers de St. Nazaire (Penhoët), France, and will be in commission this spring.

The development by the Western Electric Co. of a new type of ocean cable, loaded with "Permalloy," has been mentioned in previous reports. Extensive tests on a trial length, laid in deep water, indicated the commercial value of this type of cable, and verified the estimated increase in speed over that of all other types of deep-sea cable. Since the first transatlantic cable of 1858, all cables have been of practically the same type, differing only in size and weight. "It is gratifying to record that your company now initiates the first important change in cable laying in over fifty years."

Under an arrangement with La Compagnia Italiana dei Cavi Telegrafici Sottomarini, the Western Union will lay a cable, of the new type referred to above, from New York City to Horta, in the Azores, and the Italian company will provide a cable from the Azores to Spain and Italy, establishing for the first time direct cable connection between the United States and these two important countries, and thus affording a much-needed direct route for traffic with Southern Europe and countries beyond. This cable will probably be ready for operation by the autumn of 1924.

In April last, the transatlantic radio rates were generally raised and the corresponding cable rates reduced, resulting in approximate equality. The elimination of the rate differential, on the basis of which radio traffic had been developed, resulted in immediate and sustained additions to Western Union cable business. The effect of radio competition upon ocean cable traffic has been closely observed for several years. It is the company's experience that where cables can be assured efficient land line connections, as for example, in Great Britain, France, Italy, Germany, The Netherlands, and Belgium, the cables will hold the business as against wireless competition.

Rangoon Electric Tramways and Supply Co., Ltd.

From the 1923 profits it is proposed to allocate £35,000 to reserve for renewals; £1,592 for depreciation on sundry assets; £9,176 for Indian income tax; £5,500 for corporation profits tax; £2,838 for employés' provident fund and bonus; £27,209 for repairs, renewals, and maintenance; £9,269 for debenture stock redemption; £5,751 to reserve for the premium payable on redemption of debentures; and £10,000 to dividend equalisation reserve. A dividend of 1 rupee per share, free of tax, is to be paid to holders of ordinary shares domiciled in India, making 1¼ rupees for the year, and £16,497 is to be carried forward.

Arbroath Electric Light and Power Co., Ltd.

The report submitted at the annual meeting held last Friday stated that extensions to the generating plant were urgently required, the available plant being fully loaded. The profits for the year were £7,502, plus £1,709 brought forward, and a dividend of 8 per cent. on ordinary shares was recommended. Mr. George Balfour, M.P., the chairman, in his speech, criticised the method of valuation that existed for local rating. Electricity undertakings in Scotland were valued for rating purposes on what was known as the revenue principle. The unfairness of this system would be seen when he mentioned that in the case of a gas undertaking, for example, the basis was one-fourth of the valuation in respect of underground mains. The inequality of this system would be apparent when he mentioned that the actual figure payable for local rates for the year to Whit Sunday, 1924, was £2,593 6s. 8d., equivalent to .47d. on every kWh sold during 1923. The total rateable value of Arbroath was stated to be £124,016, while that of the electricity undertaking was £5,105. The only property which the company had above ground was the generating station, a small building, which if used for any other purpose would be rated at a few hundred pounds. The result was a tax on electricity of a halfpenny per kWh for local rates. Such a method of valuation was not an equitable one, and should be revised or amended immediately.

All-America Cables Inc.

The consolidated balance sheet to December 31st, 1923, of the All-America Cables Inc., and Mexican Telegraph Co. shows gross receipts from operations of $7,330,960, and operating and general expenses, including maintenance, repairs, and depreciation of cables, cable steamers, and shore equipment, $4,579,459. Revenue from investment and interest on bank balances, yielded $591,656, and, after deducting Federal income tax for 1923, $391,116, the net profits for the year amount to $2,952,032. The surplus at the end of the year equalled $7,047,223. The net value of plant and equipment was $22,521,205; investments, $9,344,137; spare cable, &c., $720,442; accounts receivable, $1,063,606; cash, $2,421,979. Outstanding capital amounts to $26,867,580, and reserves for fire losses, pensions, death and disability benefits, &c., to $1,109,240.

Austrian Companies.

The directors of the *Austrian Brown, Boveri Co.*, after allocations to the renewals fund, report net profits of 4,835 millions of crowns for 1923, as against 3,173 millions in 1922. The rate of dividend is 8,000 kr., or 300 per cent. per share.

The report of the *Felten and Guilleaume Co.*, of Vienna, states that although business at the Vienna cable factory left much to be desired in the early part of 1923, the situation improved in the second half through the receipt of large orders for cables both for home and foreign account. The centre of activity of this branch continued to lie in the export trade, but the markets in the adjoining countries were almost closed to the company. The net profits permit of the payment of a dividend at the rate of 15,000 Austrian crowns per share. At present the works are provided with orders, although it is only possible to obtain low prices abroad owing to foreign competition.

Brush Electrical Engineering Co., Ltd.

Mr. E. Garcke presided at the annual meeting held on Monday, at 88, Kingsway, W.C. In referring to the report, he said that the salient aspect which emerged from it was that the anticipations as to the character, volume and profits of the business in the year 1923, which he expressed at the last annual meeting, had in a large measure been realised. The demand for the specialities in electrical manufacture which characterised the work of the company had continued satisfactorily; indeed, the volume of the orders received and executed had exceeded their expectations, but the net profits had been less than in the year 1922 because the prices obtainable had been depressed by foreign and home competition. That competition, which had been excessive, had been due, as he explained last year, to the decline in business activities generally, to restriction in enterprise, and to the consequent insufficiency of general demand to absorb the established facilities for supply. Consequently, there had been increased competition for the fewer orders that were given out; and the avidity of foreign manufacturers to find a market in this country had increased the difficulties of British manufacturers, because the prices quoted for foreign machines had in many cases been below the cost of manufacture in this country. It was a great mistake to assume, as some did, that the conditions obtaining in this country were at fault. Except for the serious loss of working days due to strikes and lock-outs, and the undeniable fact that the output per man in this country was now less than it was before the war, the economic methods of manufacture and the general industrial administration here were quite as efficient and as productive as those on the Continent. The purchaser must consider whether it was to his ultimate advantage to place his orders abroad while supporting unemployed non-workers at home; or whether it would not be better to support home industries all round. The producers, on the other hand, had to consider whether there was any permanent advantage to be secured by reducing their prices to the extent of working without profit, or even at a loss, in the hope of preventing imports from abroad. The directors of that company had set their faces, and would continue to do so, against accepting orders at prices which could only be described as ruinous. The labour outlook in the engineering industry was giving cause for much anxiety, but they were not abandoning the hope that, having regard to the general situation and to the difficulties of the industry arising out of competition, the claims advanced by the engineering unions would be withdrawn, or at least postponed until the engineering industries were better able to meet them. The gross profit on trading amounted to £166,887. That showed a large falling-off as compared with 1922, and, considering the fact that in 1922 the works were closed for twelve weeks, owing to the strike in the engineering trades, and that in 1923 the volume of work done was larger than in 1922, the reduced profit shown was a significant confirmation of what he had said as to the effect of foreign and home competition and of the heavy fall in the prices obtained for their output, and of the prognostications he expressed at the last annual meeting, when he recommended a reduction of the dividend, despite the fact that the profits for the preceding year warranted the payment of a larger dividend. They had not quite earned the 10 per cent. dividend on the ordinary shares which they recommended; the shortage of £1,658 was taken out of the balance of profit carried forward. The only comment he thought it necessary to make on the balance sheet was to point out that the increased volume of work executed and in hand had necessitated an increase of the stock of goods and materials by about £30,000; had increased the debtors and sundry accounts owing to them by nearly £80,000; and had necessitated the realisation of about £26,000 of their Government securities. The amount owing by them to creditors and on sundry other accounts had increased by about £65,000. The long-outstanding questions of income tax and excess profits duty adjustments had now been settled, and, whereas at the beginning of last year they had £150,000 on deposit pending this settlement, they had during the year paid away to the Government £147,481. All arrears of taxes were now settled except corporation profits tax for 1923, which was a matter of only £2,000 or £3,000 out of the £78,524 to be carried forward. They still had about £300,000 liquid resources, so that their financial position was a strong one. Their capital was more than fully represented by assets, and the goodwill was more valuable than ever before, although it stood in the balance sheet at the nominal figure of £1. With regard to the immediate future, he could only say that the Brush-Ljungström turbo-generator continued to maintain its high position in the estimation of engineers throughout the country and in the Colonies, and one of the many gratifying features in connection with the satisfactory order list was the large number of plants which were for undertakings where Brush-Ljungström plant had already been installed. The large new turbine shops had now been completely equipped, and were adding greatly to the capacity and economy of production. The manufactures of the transformer department found increasing favour at home and abroad. That section of the works had been well occupied during the year, and prospects for the current year were satisfactory. In the rolling stock department they suffered from the effects of trade depression during the first half of the year. A recovery, however, took place in the latter part of the year, due to the improving position of the majority of the electric tramway and omnibus operating systems throughout the country, and these shops continued to be fully employed. They commenced 1924 with a greater volume of orders in hand than at the beginning of 1923, and for the first three months of this year they had been fortunate in securing new contracts to a value considerably in excess of the corresponding period of last year. The prospects of keeping the works fully going throughout the year were promising. Lord Vaux of Harrowden, seconded the motion, which was adopted unanimously without discussion.

Gateshead and District Tramways Co.

The total revenue for the year 1923 was £131,926, and after deducting expenses and providing £10,000 for renewals, there remains a balance of £28,628. To this is added £16,974 brought forward, making a total of £45,602. After contributing £1,842 to the mortgage redemption sinking fund, paying the preference dividends, and a dividend of 10 per cent. on the ordinary shares, a balance of £22,258 is carried forward. A mortgage of £75,000 was issued in June last. The work of doubling the Bensham route and a portion of the Heworth route was completed during the year, and the doubling of the remainder of the Heworth route is nearing completion. The Felling Urban District Council has agreed to defer its powers of purchase from 1929 until 1943. Through services on the systems of the Newcastle-on-Tyne Corporation and the company were instituted in January, 1923, and are proving of great benefit to the travelling public.

Belgian Companies.

The *Société Belge pour la Fabrication des Cables et Fils Electriques* reports net profits of 900,000 fr. for 1923 and the dividend is at the rate of 41.81 fr. per ordinary share, the ordinary share capital amounting to 2,000,000 fr.

The *Société Générale Belge d'Entreprises Electriques*, which is an investment company, reports an improvement in the position for 1923, the net profits having amounted to 3,152,000 fr. as compared with 2,452,000 fr. in 1922, after the holdings had been written down by 1,184,000 fr. and 1,308,000 fr. in the two years respectively. It is proposed to pay a dividend at the rate of 10 per cent. on the ordinary share capital of 25,000,000 fr. as against 8 per cent. in 1922.

La Société Générale Belge d'Entreprises Electriques, of Brussels, reports a net profit of 3,152,253 fr. for last year, as compared with only 2,452,736 fr. for 1922. The capital of the undertaking is 25 million fr.

French Companies.

The report of the *Société des Tramways Electriques et Omnibus de Bordeaux* for last year shows that a net profit of 2,267,844 fr. was made, as compared with 2,578,628 fr. in 1922.

The capital of the *Société de l'Energie Electrique*, of Paris, is being increased from 37½ to 40 million fr. with the object of acquiring a number of small undertakings, including the Société de l'Electricité de Chartres, the Société de Gaz et Electricité de Frejus-Saint-Raphael, the Société de l'Electricité de Samoy, the Société de l'Electricité de Chatelet-en-Brie, and the Usine Hydro-electrique de Soeix at Oloron.

The year 1923's working of the *Energie Electrique Suburbaine de Nancy* yielded a net profit of 466,660 fr., against 256,931 in 1922, from which a dividend of 8 per cent. gross was proposed. It is relegated to an extraordinary meeting to decide on the increase of the company's capital from 900,000 fr. to 2,500,000 fr.

The accounts of the *Société Havraise d'Energie Electrique* for 1923 showed a gross profit of 21,622,188 fr., against 15,107,768 fr. for the previous year. The net profit totalled 4,718,230 fr., after allotting 750,000 fr. to capital sinking fund and 2,267,205 fr. to the network sinking fund. The board proposed the distribution of 35.50 fr. to the capital shares and 27.50 fr. to shares *de jouissance*, against 27.50 fr. and 17.50 fr. in the past year.

An extraordinary meeting of the *Compagnie d'Entreprises Electro-mécaniques* has decided to raise its capital from 2,000,000 to 10,000,000 fr.

The report of the *Est-Electrique* for 1923 showed a credit balance of 1,813,795 fr., plus 26,452 fr. brought forward. A gross dividend of 17.50 fr. to priority and ordinary shares, of 17.18 fr. to ordinary shares to bearer and priority shares, and of 40.47 fr. to *parts beneficiaires* was distributed. The capital is to be increased from 6,000,000 fr. to 30,000,000 fr. in several stages.

Swedish Company.—The directors of Luth and Rosens Elektriska A.B. report a loss of 824,000 kronen for 1923 as compared with a loss of 1,855,000 kr. in the previous year. It is stated that the unfavourable results were due to a considerable extent to the long conflict in the iron industry and its effects on the activity of the company. The export trade steadily increased during the year. The ordinary share capital amounts to 8,150,000 kr.

Tynemouth and District Electric Traction Co., Ltd.—The report states that the revenue for 1923 was £41,990, and after meeting expenses and providing £3,185 for renewals, there was a balance of £4,713. To this was added £4,454 brought forward, making £9,167. A dividend of 10 per cent. on the ordinary shares requires £6,166, and a balance of £3,001 is carried forward.

Stock Exchange Notices.—The undermentioned have been officially ordered to be quoted :—

American Telephone and Telegraph.—$12,273,700 capital stock.

Enfield Cable Works.—200,000 7½ per cent. preference shares of £1 each, fully paid, Nos. 1 to 200,000.

Traction and Power Securities.—£256,230 ordinary stock and £427,050 5 per cent. cumulative preference stock.

Clyde Valley Electrical Power Co.—60,000 ordinary shares of £10 each, fully paid (Nos. 1 to 60,000), 30,000 6 per cent. cumulative preference shares of £10 each, fully paid (Nos. 1 to 30,000), and 50,000 8 per cent. cumulative second preference shares of £10 each, fully paid (Nos. 1 to 50,000).

Scottish Power Co.—250,000 ordinary shares of £1 each, fully paid (Nos. 1 to 250,000), and 250,000 8 per cent. cumulative preference shares of £1 each, fully paid (Nos. 1 to 250,000).

Dealings in the following have been specially allowed by the Committee under Rule 159 :—

Cawnpore Electric Supply.—78,507 seven per cent. cumulative preference shares of £1 each, fully paid, Nos. 120,001 to 198,507.

Clyde Valley Electrical Power.—60,000 ordinary shares of £10 each, fully paid, Nos. 1 to 60,000; and 30,000 six per cent. cumulative preference shares of £10 each, fully paid, Nos. 1 to 30,000.

Fife Tramway Light and Power.—240,000 new six per cent. cumulative preference shares of £1 each, 5s. paid and fully paid, Nos. 260,001 to 500,000; and 40,000 new ordinary shares of £1 each, issued at £1 2s. per share, of which 5s. is paid and fully paid, Nos. 460,001 to 500,000.

Madras Electric Tramways (1904).—£130,000 five and a-half per cent. debentures (registered), issued at 93 per cent., partly paid and fully paid, Nos. 1 to 1,300.

Jarrow and District Electric Traction Co., Ltd.—The total revenue for 1923 was £11,600, and after deducting all expenses, including a provision of £800 for renewals, and adding £1,234 brought forward, there remains a balance of £1,825, which is being carried forward.

Peterborough Electric Traction Co., Ltd.—The revenue for 1923 was £21,976, and the balance, after meeting expenses, including debenture interest and provision for renewals, was £1,537. This was brought up to £1,739 by the balance brought forward. After payment of the preference dividend, £419 is carried forward.

Oerlikon Accumulator Company.—The report for 1923 states that the works were uniformly occupied and the turnover improved as compared with 1922, when there was a decline. The net profits were 610,000 fr., as against 601,000 fr. in 1922, and the dividend is at the rate of 20 per cent. on share capital of 2,300,000 fr.

Phillips Glow Lamp Co. of Eindhoven.—The accounts of this company for 1923 are reported to show gross profits of 5,638,000 florins. After having written off 2,093,500 fl. for depreciation the net profits are 3,544,500 fl. There is an appropriation of 1,300,000 fl. for further depreciation; 7 per cent. is paid on the preference capital; and 11 per cent. on the ordinary shares is distributed as in 1922. The directors report that all the departments were fully occupied last year and the extension of the export organisation made further progress. Important inventions were made from the working of which specially favourable results are expected.

General Electric Co.—According to the *Financial Times*, the net income for 1923 was $38,001,528, and the profit available $33,525,118. The surplus, after paying 6 per cent. cash dividend on special and 8 per cent. cash dividend on common stocks, was $18,579,423 plus $73,167,047 brought in. Five per cent. dividend was paid in special stock, the ultimate surplus being $82,762,095.

Mexborough and Swinton Tramways Co.—After transferring £1,500 to the reserve and renewals account, reserving £1,000 for income tax, and £9,674 for repairs and maintenance, a dividend of 3 per cent. is paid, leaving £530 to be carried forward.

Western Electric Co.—The *Financial Times* summary of the report for 1923 states that the sales totalled $255,177,000, representing the largest volume of business ever done by the company. The net earnings, after providing for depreciation of plant and taxes, were $10,079,471, less interest on borrowings $1,159,958, leaving $8,919,513. Dividends of 7 per cent. on preferred and 10 per cent. on common stocks are being paid, leaving $2,191,941 carried to common stock.

Victoria Falls Power Co.—The net earnings, including those of the Rand Mines Power Supply Co., for the quarter ended December 31st, 1923, amounted to £235,511, before providing for British and South African taxation.—*Financial Times.*

Ever-Ready Co. (Great Britain), Ltd.—Final dividend of 6½ per cent. (making 10 per cent. for the year) on both preference and ordinary shares.

Commonwealth Edison Co.—Quarterly dividend of **$2** per share on capital stock, payable May 1st.

Stocks and Shares.

MONDAY EVENING.

THE immediate factor of consequence in the Stock Exchange markets is, of course, the advent of the Budget. The details to be announced on Tuesday evening have been industriously canvassed in advance, and if the prophets prove to be right, as is likely, the effect of the Chancellor's statement will be negligible in the Stock Exchange markets. Any increase in death duties, super-tax, or other imposition upon wealth, has an indirectly unfavourable influence over Stock Exchange securities, in that it leads to an increase in the automatic amount of selling which goes on continuously. There is, however, such a demand for first-rate investments at the present time that it would be an advantage rather than the reverse to have the area of choice widened, though, of course, the effect of heavier taxation comes very slowly and almost imperceptibly.

The market for electricity supply shares remains in a waiting mood. There is a good deal of business going on, without producing noticeable alterations in the prices. Edmundsons ordinary are 7s. 6d. up at 5½ on the expectation of a 10 per cent. dividend being declared, against 7 per cent. paid for the previous year. South Londons are 1s. 3d. lower, and Newcastle-on-Tyne ordinary gave way to 18s. 9d., business having been recorded at 18s. 3d. Shareholders in the supply companies are waiting with keen expectancy for the outcome of the negotiations that are expected to result in the extension of the companies' tenure of life for another forty years beyond 1931, accompanied by the necessity for them, the companies, to adopt a sliding scale. While this is in suspense, it is not likely that there will be any marked change in prices, though when the matter is settled, the removal of uncertainty should lead to a further development of activity in the share market.

Underground Electric ordinary stocks and shares are a good market, with a rise to £3 and the "A" at 8s. 6d. are 1s. higher. Metropolitans hold all but 10s. of their 4½ points rise last week, and Districts are steady at 54½. Central London Assented preferred ordinary stock changed hands the other day at 70½, and a little business has been done lately in East Londons, on the basis of 5½. The early visitors to the British Empire Exhibition may be forgiven a feeling of disappointment at the unpreparedness everywhere apparent. Some of the exhibits are ready, but, taken as a whole, the Exhibition strikes one as being incomplete. Electrical manufacturing companies should score good results from an Exhibition, which, when it is finished, will certainly be one of the finest ever opened to the public.

Cable stocks retain their strength. Globe ordinary are again ½ up to £18, a price which causes Westerns and Eastern Extensions at 17½, as well as Eastern ordinary at 172½, to look relatively cheap. Great Northerns are 5s. better at 28½. Cuba Submarines fell to 7. Anglo-American Telegraph Preferred at 102½ has recovered the dividend deducted from the price last week.

The River Plate Electricity Company announces a dividend of 8 per cent., against 7 per cent. a year ago, and the price of the ordinary stock has risen to 170. The Board advise their fellow-shareholders to agree to the sale of the undertaking to an Argentine Company, on terms which are decidedly favourable. So good are these, in fact, that the proper value of the stock looks to be worth nearer 200 than the current quotation, and proprietors are not likely to refuse the tempting offer now made to them.

Wireless shares derived some little advertisement from the successful broadcasting of the speech made by the King at the opening of the Empire Exhibition. Marconis reached 34s., but the price soon dwindled to 32s. 6d. Canadians are dull at 4s. 9d. Chile Telephones have lost 5s. at 6, on fears of competition in Santiago. The company's concession expires at the end of this year, and the Chilean Government makes it a condition of renewal that there shall be an improvement in the service.

The Electric Light and Power Contracts Finance Corporation, Limited, is inviting subscriptions to its 19,000 8 per cent. preference shares of 10s. each at par and £25,000 8 per cent. participating premium notes of £1 each, at par. The dividends on the preference shares are free of income-tax. Omission of the name of the company's bankers from the prospectus is singular. The Corporation proposes, *inter alia*, to engage particularly in the establishment, development, finance, underwriting and construction of electric light and power undertakings: to acquire an interest in an "important power plant invention"; and to supply its share and note holders with fittings at 5 per cent. over the cost price to the Corporation. The remarkably high rates of dividend and interest offered on the shares and notes respectively are sufficient in themselves to convey caution to the mind of the wary investor.

General Electrics have hardened to a guinea. Edisons are firmer at 5s. Metropolitan-Vickers preference at 2 7/16 are ex dividend. Babcock & Wilcox strengthened a little upon proposals that the company shall enter into an arrangement with Clayton & Shuttleworth, whereby a close alliance of interests will become assured. The cable manufacturing shares are all very steady.

London United Tramway debenture fell 2 points to 47. On the other hand, British Electric Traction has risen to 75. Foreign tramway issues show no changes of consequence, Mexicans remaining motionless, and British Columbia Electric Railway stocks again being in request. The iron and steel market is rather better. Rubber has gained a small fraction at 1s. 0¼d. per lb., but public interest in the share market is languid and academic.

Share List of Electrical Companies.

HOME ELECTRICITY COMPANIES.

	Nom. £	Dividend. 1922.	Dividend. 1923.	Price April 28, 1924.	Rise or fall.	Yield. p.c.
Brompton Ordinary	1	12	10	37/-	—	*£5 8 1
Charing Cross Ordinary	1	14	14½	29½	—	6 16 6
do. do. do. 4½ Pref.	1	4½	4½	17/-	—	5 6 0
Chelsea	1	10	12	15	—	6 8 0
City of London	1	15	15	45/9	—	6 11 0
do. do. 6 % Pref. ...	1	6	6	23/6	—	5 2 2
County of London	1	10	15	45/9	—	6 11 0
do. do. 6 % Pref. ...	1	6	6	1⅛	—	5 6 8
Edmundson's Ordinary	3	7	7	5½	+ ⅛	4 2 7
do. 6 % Pref.	5	6	6	5⅛	—	5 17 1
Kensington Ordinary	5	12	14	10	—	7 0 0
London Electric	1	10	10	31/-	—	6 9 0
do. do. 6 % Pref. ...	5	6	6	5⅜	—	5 11 7
Metropolitan	1	8⅛	10	12	—	5 14 8
do. 4½ % Pref.	1	4½	4½	17/-	—	5 6 0
Newcastle-on-Tyne Ordinary ...	1	2½	6	18/9	—9d.	6 8 1
do. 5 % Pref. ...	1	5	5	16/9	—	5 19 5
do. 7 % Pref. ...	1	7	7	23/6	—	5 19 2
Notting Hill 6 % Pref.	10	6	6	9½	—	6 6 4
North Met. Elec. 6 % Pref. ...	1	6	6	21/£xd	—	5 13 0
Urban Ordinary	1	—	—	1	—	Nil
do 6 % Pref. ...	1	5	6	1xd	+6d.	6 0 0
St. James' and Pall Mall ...	5	14½	17½	18½	—	6 13 4
South London	1	11	15	42/-	—1/3	6 7 2
South Metropolitan Pref. ...	1	7	7	1¼	—	5 12 0
Westminster Ordinary	5	12	15	10⅞	—	7 1 2
Whitehall Elec. Invst. 7½ % Pref.	1	7½	7½	20/6	—	7 6 4

HOME RAILS.

Central London Ord. Assented	Stock	4	4	68½	—	5 16 10
Metropolitan	,,	3½	4	82	— ½	4 17 7
do. District	,,	3	3½	54½	—	6 8 5
Underground Electric Ordinary	10	Nil	Nil	3	+ ⅛	Nil
do. do. "A" ...	1	Nil	Nil	8/6	+1/-	Nil
do. do. Income Bonds	5	6	6	97	—	*6 3 9

TELEGRAPHS AND TELEPHONES.

		Dividend. 1921	Dividend. 1922			
Anglo-Am. Tel. Pref.	Stock	6	6	102½xd	+1	5 17 1
do. Def.	,,	1½	94/6	23½	—	6 9 0
Chile Telephone	5	6	6	6	— ⅛	5 0 0
Cuba Sub. Ord.	10	7	7	7	— ⅛	10 0 0
Eastern Extension...	10	10	10	17⅛	+ ⅛	5 16 8
Eastern Tel. Ord.	Stock	10	10	172½	—	5 16 0
Globe Tel. and T. Ord.	10	10	10	18½	+ ½	5 10 4
do. do. Pref.	10	6	6	10⅞	—	5 11 7
Great Northern Tel.	10	24	22	23½	+ ½	7 16 0
Indo-European	25	10	7	32½	—	*5 7 8
Marconi	1	25	15	1⅝	—	9 4 8
Oriental Telephone Ord.... ...	1	12	12	1½	—	*6 17 2
United R. Plate Tel.	5	8	8	7	+ ⅛	*5 14 6
West India & Panama	10	Nil	Nil	1/-	—	Nil
Western Telegraph	10	10	10	17	+ ⅛	5 16 8

HOME AND FOREIGN TRAMS, &c.

Anglo-Arg. Trams First Pref. ...	5	5½	12½	3⅛	—	8 9 0
do. do. 2nd Pref. ...	5	Nil	5½	2½	—	10 4 4
do. do. 5% Deb. ...	Stock	5	5	73½	—	6 16 3
British Electric Traction Ord. ...	,,	4½	5	75	+1	6 13 4
do. do. 6% Pref.	,,	6	6	99½	—	6 0 6
Brazil Traction	100	Nil	4	67xd	—	7 0 4
Brit. Columbia Elec. Rly. Pce.	Stock	5	5	84½	—	5 18 4
do. do. Preferred	,,	5	96/-	84½	—	*5 14 0
do. do. Deferred	,,	8	127/-	102½	+1	*6 6 3
do. do. Deb.	,,	4¼	4¼	78½	—	5 8 3
Lond. & Sub. Trac. 5 % Pref. ...	1	8½	5	6/-	—	8 6 8
London United Tram. Deb. ...	Stock	4	4	47	—3	8 10 2
Mexico Trams. 5% Bonds ...	—	Nil	Nil	75½	—	6 16 0
do 6% Bonds ...	—	Nil	Nil	50½	—	Nil
Mexican Light Common ...	100	Nil	Nil	22½	—	Nil
do. Pref.	100	Nil	Nil	46½	—	Nil
do. 1st Bonds ...	—	Nil	5	68½	—	7 6 0

MANUFACTURING COMPANIES.

Babcock & Wilcox...	1	15	20	2⅜	—	*5 1 1
British Aluminium Ord.... ...	1	10	5	23/3	—	4 5 10
British Insulated Ord.	1	15	15	2⅛	—	6 3 0
Callenders	1	15	15	48/9	—	6 3 0
do. 6½ Pref....	1	6½	6½	23/9	—	5 9 5
Crompton Ord.	1	10	5	⅞	—	8 17 10
Edison-Swan	4/-	Nil	7½	5/-	+3d.	6 0 0
do. ,, 5% Deb.	Stock	5	5	78½	—	6 7 5
Electric Construction	1	10	10	1⅛	—	6 7 6
English Electric	1	8	5	17/6	—	5 14 3
do. do. Pref.	1	6	6	19/-	—	6 6 4
Gen. Elec. Pref.	1	6½	6½	23/6	—	5 10 8
do. Ord.	1	10	5	21/-	+6d.	4 15 3
Henley	1	15	15	2⅛	—	6 3 0
do. 4½ Pref.	5	4½	4½	4½	—	5 9 1
India-Rubber	1	10	10	1½	—	*7 5 6
Met.-Vickers Pref....	2	8	8	2⅞xd	—	6 11 2
Siemens Ord.	1	10	10	18/8	—	Nil
Telegraph Con.	12	20	20	24	—	*5 0 0

* Dividends paid free of Income Tax.

Market Quotations for Chemicals and Metals.

IT should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general and they may vary according to quantities and other circumstances

CHEMICALS, &c.	Price April 29.	Fortnight's Inc. or dec.
a Acid, Oxalic ... ... per lb.	5½d.	...
a Ammoniac, Sal ... ... per ton	£69	...
a Ammonia, Muriate (large crystal) ,,	£52	...
a Bisulphide of Carbon ... ... ,,	...	...
a Borax ... ... ,,	£25	...
a Copper Sulphate ... ... ,,	£25 10s.	...
a Potash, Chlorate ... ... per lb.	4d. to 4½d.	...
a ,, Perchlorate ... ... ,,	4½d.	...
a Shellac ... ... per cwt.	£15 15s.	...
a Sulphur, Sublimed Flowers ... ,,	£7 15s.	...
a ,, Roll ... ... ,,	£7 15s.	...
a Soda, Chlorate ... ... per lb.	3d.	...
a ,, Crystals ... ... per ton	£5 to £5 5s.	...
a Sodium Bichromate, casks ... per lb.	4½d.	...
METALS, &c.		
b Aluminium, Ingots ... ... per ton	£125 to £130	£5 inc.
b ,, Wire ... ... per lb.	1/9 to 2/6*	...
b ,, Sheet ... ... ,,	1/6 to 2/-	...
p Babbitt's Metal and Anti-friction Metal—		...
Grade I ... ... per ton net	£225	£5 dec.
Grade II ... ... ,, ,,	£161	£3 dec.
Grade III ... ... ,, ,,	£89	£1 dec.
c Brass (rolled metal 2" to 12" basis) per lb.	9½d.	½d. dec.
c ,, Tubes (solid drawn) ... ,,	1/0½d. to 1/0½d.	...
c ,, Wire, basis ... ... ,,	10½d.	½d. dec.
c Copper Tubes (solid drawn) ... ,,	1/1½d.	...
c ,, Bars (best selected) ... per ton	£96	£2 dec.
c ,, Sheet ... ... ,,	£96	£2 dec.
c ,, Rod ... ... ,,	£96	£2 dec.
d ,, (Electrolytic) Bars ... ,,	£89 15s.	15/- dec
d ,, ,, Sheets ... ,,	£145 10s.	...
d ,, ,, Wire Rods ,,	£79 15s.	15/- dec.
d ,, ,, H.C. Wire per lb.	10 ⅛d.	⅛d. dec.
f Ebonite Rod ... ... ,,	2/- to 3/6	...
f ,, Sheet ... ... ,,	2/- to 3/6	...
n German Silver Wire ... ... ,,	2/3	...
h Gutta-percha, fine ... ... ,,	nom.	...
h India-rubber, Para fine ... ... ,,	11½d.	...
Iron Pig (Cleveland Warrants) ... per ton.	£5 2s. to £5 2s. 6d.	...
i ,, Wire, galv. No. 8, P.O. qual. ,,	£25	...
g Lead, English Pig ... ... ,,	£33	5/- in
g Mercury ... ... per bot.	£13 15s. to £14	...
e Mica (in original cases) small ... per lb.	3d. to 3/-	...
e ,, ,, medium ,,	4/- to 8/-	...
e ,, ,, large ... ,,	10/- to 20/- & up.	...
p Phosphor Bronze, plain castings ,,	1/3½	...
p ,, ,, drawn bars & rods ,,	1/4	...
p ,, ,, rolled strip & sheet ,,	1/3½	...
p ,, ,, wire ... ... ,,	1/4	¼ dec.
o Platinum ... ... per oz.	£23	£1 inc.
d Silicium Bronze Wire ... ... per lb.	1/0½	...
r Steel, Magnet, in bars ... ... ,,	10d.	...
n Tin, Block (English) ... ... per ton.	£241 15s. to £242	£2 5s. to £2 10s. dec.
n ,, Wire, Nos. 1 to 16 ... ... per lb.	4/2	...

*For 1 cwt. lots. Special quotations against definite specifications.

Quotations supplied by

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p C. Clifford & Son, Ltd.
r W. F. Dennis & Co.

Adulterated Electricity.—In the course of a discussion at a recent South London Ratepayers' Association on the subject of the high charges for electricity supply, one member seriously asked the question whether it was possible to adulterate electricity as gas was adulterated. He was certain that the current he was getting was not so good as that formerly supplied. Oh, these post-war products!

The Metric System to be Adopted in Siam.—The use of the metric system of weights and measures has been authorised by law in Siam, under date of December 17th, 1923. The law, however, does not come into effect until 12 months after that date, and is not to be compulsory until five years later, by the publication of a royal decree in the Government Gazette. Goods imported into the Kingdom, which are packed according to the weights and measures of foreign countries and which cannot be conveniently unpacked, may be sold or otherwise dealt with in commercial transactions in the original containers in which they were imported, and goods exported to foreign countries may be described according to the weights and measures of the countries to which they are exported. In every case, however, the quantities of such goods must, in addition, be expressed in terms of equivalents published by the Minister for the purpose. The Minister of Commerce is charged with the execution of the law, and is empowered to issue the necessary ministerial regulations for its enforcement. A central bureau has been established, where standards of the units of the system will be preserved and which will issue licences to manufacturers, importers, repairers, and sellers of weighing and measuring instruments, its functions to include the registration, verification, and inspection of all such instruments in use.—*Commerce Reports.*

Overhead Electric Power Transmission.

Elements of Design and Economics.

By WILLIAM T. TAYLOR, M.Inst.C.E., M.I.E.E.

(*Concluded from page* 647.)

High efficiency means less loss; on the other hand, it usually means a more costly system, and sometimes (not always) a more reliable system and one offering a better voltage regulation. That is to say, we may apply better factors of safety, install duplicate transmission lines or circuits and/or units in the stations, install better lightning protection equipment, and also install synchronous condensers for phase compensation, &c. The energy loss is variable according to the periodic variation of power and power factor, the number of transformers in service, their time-period in service, &c., and the total energy loss in kVA-years is dependent on the ohmic loss in the line conductors, copper and magnetic losses in the power transformers, and the system load factor. The ohmic loss in the conductors depends on the amount and power factor of the load and on the size and length of conductors; the magnetic loss in the transformers is practically independent of the load. When the load factor is high, the ohmic loss will tend to increase and the annual expense to decrease.

Power factor must be taken into account, as it has a direct influence on the cost of transmission. The economy of transmission changes very rapidly with a small change in line power factor, but it changes very slowly over a wide range of delivered load. Thus a considerable increase in load can be allowed for when designing a new line without sacrificing present economy. A power factor of 0.8 calls for practically a 25 per cent. increase in the number of kVA, which means that the complete circuit apparatus, lines, &c., must be increased by practically the same percentage for the same revenue-earning load. Power factor has a very great influence on the cost and the selling price of energy.

At the present time it is sometimes found desirable to adopt a voltage corresponding to that of other lines operating in the vicinity in order that the line may operate in parallel without the introduction of transformers which may involve both a cost and a hazard. The determination of the proper line voltage requires a cost study made up of two parts, namely, the cost of energy lost, and the cost of the line and the transmitting and receiving apparatus and equipment. The amount, and thus the cost, of energy lost in a given transmission line in delivering a given amount of power at the receiving end of that line decreases if the voltage at which that power is transmitted be increased, but such an increase in voltage necessitates an increase in cost. Thus, under a given set of market conditions, the voltage at which a given amount of power will be delivered to a distant point at the least cost is limited to that value at which the sum of the cost of losses resulting and cost of line, transmitting and receiving apparatus, &c., is a minimum.

If the voltage be doubled, the weight of conductors will be reduced to one-fourth with practically a corresponding reduction in cost. For a given energy loss in transmission, this cost will increase slightly for the very-high-voltage lines due to corona and leakage losses and charging current; any change in line current will be accompanied by a change in the energy loss. The most *economical* voltage for any line is that which gives the lowest estimated first cost when conductors, line supports, insulators, transmitting and receiving (terminal) apparatus, erection costs, maintenance costs and the amount and cost of energy are considered. The most *economical* voltage for long lines is the highest voltage possible without excessive corona loss, upon a conductor of Kelvin's economic cross-section. Both the amount and the cost of energy to be transmitted are very important factors in determining the economic transmission voltage.

Since the line current for a given load is decreased as the voltage is increased, the voltage necessary to overcome the total line reactance will be less; for instance, if we double the line voltage the current will be reduced to one-half for the same delivered power, and the reactance-volts drop will be one-half, resulting in one-fourth the percentage of the reactance-volts drop for the same spacing of line conductors. On the other hand, the charging current which also varies as the square of the voltage will be double, and the charging kVA will be four times for double the line voltage. Judging from a rough estimate for various distances, load centres, &c., it would seem to the writer that the most desirable transmission voltage for this country would be around 44,000 to 66,000 volts, excluding the far-distant hydro-electric schemes.

For the larger high-voltage lines, the four principal variables controlling the choice of line voltage are:—

(1) Cost of Line.

This is dependent on the length of transmission and the number of conductors, line voltage, power and power factor, locality, market conditions, &c. For very-high-voltage power lines, the cost of the line supports and insulators may increase to a point where they outweigh any saving in conductor cost which might be obtained by further increase in line voltage.

(2) Cost of Terminal Apparatus, &c.

This is dependent on the kVA capacity and the voltage, which in turn are dependent on the length of transmission. The line is usually long enough to prevent the cost of terminal apparatus, &c., from controlling the choice of line voltage.

(3) Line Drop.

In some cases the line drop may be excessive when the economic voltage is used, in which case the economic size of conductor must be departed from and a larger one used. The larger size of conductor will permit the use of a higher voltage, and this will improve the line drop. For all big lines the use of synchronous condensers would largely control the line drop.

(4) Charging Current.

While the line current is decreasing with an increasing voltage, the charging current is increasing and may reach a value much in excess of the load current.

With regard to the total cost of the entire transmission system, this cost will increase with the increase of transmission distance, and with the increase in kVA capacity (but not always). On the other hand, the line voltage will increase with an increase in kVA capacity, distance of transmission, cost of energy, load factor, and with a decrease in the annual expenses. For a definite annual generating cost of energy per kVA-year, transmission distance, and total kVA capacity, there is a *minimum* cost for a certain line voltage.

The design of very-high-voltage power transformers is much more of an art than the design of transformers for use on the ordinary power service mains, for the reason that the question of insulation is not merely a matter of the insertion of so much paper interspersed with insulating fluid, but careful consideration must be given to avoid concentration of electric stress at the edges of the high-voltage coils which are adjacent to the iron and low-voltage winding of the transformers. The arrangement of the circuits on which the transformers are to be used will have a

dominant influence on the arrangement of coils and insulation in each transformer; for example, in the case of a very-high-voltage system, the coil arrangement for a star-connected bank of transformers would not be appropriate for delta connection.

In designing the coil space and insulation, arrangements giving uniform field and logarithmic potential are found most favourable, and in many cases the winding may be distributed and form part of the insulation. Certain allowance must be made in the space occupied by a conductor, the principal being: (*a*) to provide sufficient ventilation to carry off the heat dissipated due to the energy loss; (*b*) to provide for its insulation against adjacent conductors; (*c*) to provide for imperfections in winding and variations in dimensions of materials. In like manner in the space occupied by the iron, allowance must be made for mechanical imperfections in building-up and for the space occupied by the ventilating ducts. In the usual problem the flux density in the iron is fixed as well as the current density in the copper. The clearances for oil alone and along the surfaces of insulating material are much larger than for space interspersed with fibrous or other solid insulating material. When the voltage is high, the space for insulation has to be large, and this will increase the mean length of iron core and conductors. But when the voltage is high compared with the kVA capacity, and assuming that the transformer is designed from the viewpoint of the most economical transformer, then the voltage regulation might exceed the limit on account of the many turns of the windings; hence, the bases of design are different for different voltages and capacities.

From a study of the principal factors which control the most economical design of power transformers, the following summarisation is made:—

(1) The net area of the iron core is directly proportional to the induced voltage and inversely to the flux density.

(2) The mean length of the copper windings is dependent on the peripheral length of the core section, on the cross-section of copper, and on the space for insulation.

(3) The mean length of iron core (or magnetic path) is approximately dependent on the section of core and on the peripheral length of the space for windings and insulation.

(4) The volume of insulating space is proportional to the mean length of copper, to the depth or thickness of insulation, and to the mean of the peripheral lengths of cross-sections of copper and of the space for copper and insulation.

(5) The m.m.f. for the leakage flux is approximately proportional to the total ampere-turns, and the corresponding magnetic reluctance is approximately proportional to the mean length of core and inversely to the mean length of conductor and the thickness of insulation.

(6) The cost of insulation is proportional to the voltage and the square root of the kVA capacity, and is independent of the voltage induced per turn of winding.

(7) The cost of the transformer will depend upon the type, the kVA capacity, the voltage, and the frequency. For a higher frequency and kVA capacity, the difference in cost will be less, depending on whether the self-cooled or the water-cooled type is used.

(8) The cost of a transformer will increase with the increase in voltage and/or kVA capacity. When the kVA capacity increases, the cost will increase, due to the increase in the mean lengths of active materials and the cross-sectional areas. When the voltage increases, the mean length of copper will increase, while its cross-sectional area will decrease slightly, but the volume of iron will increase greatly.

(9) There is a minimum value of total cost of transformer for the variation of voltage induced per turn of winding.

(10) When a transformer voltage is high compared with the kVA capacity, the limitation of voltage regulation may become the predominating factor on account of the many turns of winding.

(11) As the voltage per turn for very-high-voltage transformers has to be increased regardless of the most economical conditions (more particularly in those cases where the kVA capacity is small), the cost of the transformer may be increased beyond the most economical point.

(12) In figuring the total transformer kVA capacity for one sending generating or sub-station and one receiving generating or sub-station, the value varies from 2 to 4 times that of the kVA capacity transmitted.

(13) The total increase in cost of a transformer by the increase in voltage is different in magnitude for different kVA capacity and voltage.

(14) The cost due to kVA capacity consists of copper and iron. The cost of insulation is dependent on the total area of copper surface and the depth or thickness of insulation. The cost of insulation is usually small as compared with copper and iron; it is proportional to the voltage and the kVA capacity.

The cost of wayleaves will increase with the kVA capacity and line voltage, and increase in direct proportion to the distance of transmission, and according to the country and locality and the respective local conditions.

In conclusion, we find from close study of the principal factors controlling the most economical design of an overhead power transmission line that:—

(1) A long transmission line will require a high voltage to satisfy the most economical conditions.

(2) When the transmission distance is great, the cost due to the ohmic loss in the line conductors and that due to the annual expense of conductors, line supports, insulators, wayleaves, and miscellaneous items, will tend to increase proportionally.

(3) For a definite kVA capacity, the annual expense will decrease with a decrease in line voltage.

(4) For a definite line voltage, the annual expense will increase with an increase in the kVA capacity, and *vice versa*.

(5) For an increase in generating cost of energy with a definite transmission distance, span length, and delivered load, there will result an increase in the size of conductors and line voltage, but a decrease in the transmission cost per kVA- or kW-year.

(6) For an increase in the distance of transmission with a definite generating cost of energy, span length, and delivered load, there will result an increase in the line voltage, transmission cost of energy, and the cross-sectional area of conductors.

(7) For an increase in the delivered load with a definite generating cost of energy, transmission distance, and span length, there will result an increase in the line voltage and size of conductors, but a decrease in the transmission cost of energy per kVA- or kW-year.

(8) The spacing of line conductors and the frequency of supply has an important effect on the maximum carrying capacity (kVA) of a power transmission.

(9) Usually the power limits of a transmission system are increased by the use of larger conductors or an increase in line voltage.

(10) The power factor, particularly in the case of very big power lines, may become the all-important feature of the line, serving as the only feasible means of controlling voltage and efficiency: it must be completely under control. The advantage of installing synchronous condensers for phase and voltage control is very much dependent on the load curve, and the economical design will be governed by the variations of load. It is more favourable to provide most of the power-factor correction as far as it is required to raise the power factor of the load in the neighbourhood of the load itself, as this will improve the regulation and efficiency performance of the system as well as adapting the load to the requirements of the line; it will also reduce the kVA load on the power transformers.

(11) The size of conductor should not be increased indefinitely, except to reduce economically the power loss consistent with the increased cost of transmission line. In a very-high-voltage transmission system, the corona effect may require a conductor size above which no appreciable gain in power-carrying capacity will be obtained.

Pulverised Coal Firing v. Mechanical Stokers.

By W. D. WYLDE.

THE merits and claims of pulverised fuel for boiler firing purposes have been given a fair share of publicity in the technical Press, and, if all were well, it might be safely assumed that the days of low boiler efficiencies had passed away; but after all the visions of wonderful efficiencies have faded away, it becomes necessary to study the bare facts that remain: that the pulverisation of coal does not increase its calorific value, and does not decrease the ash content, but simply, as the name implies, breaks up the coal into a powdered state, and by the drying process removes the moisture content.

This absorption of the moisture before the coal enters the furnace means economy only when the saving obtained justifies the installation and upkeep of drying plant, even when utilising the waste heat from the flue gases for drying purposes. The consumption of one ton of pulverised coal of a specified calorific value, under complete combustion conditions, will not evaporate any more water than the consumption of one ton of the same coal under the same conditions, using a chain-grate stoker, for the simple reason that pulverisation cannot extract more heat from the coal than the coal contains. Therefore the only claim that can be considered is whether pulverised coal is burnt more efficiently than the same coal fired with mechanical stokers.

The fact of a plant being inefficiently operated does not increase the claims of a different method of boiler firing until the maximum efficiency that is obtainable from the existing method of firing has been achieved.

Higher furnace temperatures are claimed when using pulverised coal. The temperature that exists below the surface of a radiant mass of burning fuel, with complete combustion on the grate of a furnace firing solid fuel, reaches the same degree as that reached by the brickwork of the furnace when firing pulverised fuel of the same heat value, the only difference being slower distillation of the volatile products when using mechanical stokers: the same heat being available, the same temperature can be attained, and as long as the maximum heat is obtained from the fuel and absorbed by the heating surface of the boiler, the temperature of the furnace brickwork is a minor consideration from a heat transmission point of view—but it is of great importance from a maintenance and repair point of view.

A very high percentage of CO_2 in the flue gas analysis is claimed when using pulverised coal: percentages on the border line of efficiency decrease due to insufficient air supply.

Complete control of the air supply necessary for combustion is the cause of high combustion efficiency, and the same complete control applied to mechanical stokers would enable the same results to be obtained.

The majority of modern boiler-house plants are credited with only being able to maintain an average of 10 per cent. of CO_2 in the gases leaving their combustion chambers: assuming that this is correct, no wonder pulverised fuel advocates take advantage of such a figure for propaganda purposes.

Claims of flexibility, rapid steam raising, elimination of banking losses, and the absence of combustible content in the ash are only a few of those submitted in support of pulverised fuel.

Considering the variable grate speed and thickness of fire regulation that can be obtained with the mechanical stoker, it cannot be said that flexibility does not exist; and with the grate speed and fire thickness under control, the rapid raising of steam is a foregone conclusion with the mechanical stoker.

Modern boilers are capable of carrying abnormal overloads quite comfortably, which removes the necessity of boiler fires being kept banked, and for this reason the elimination of banking losses cannot be claimed by either method of boiler firing.

Coal, unfortunately, contains incombustible matter. Varying grades contain varying percentages of incombustible content, and no method of boiler firing at the present time can claim to remove this useless content before the completion of the combustion cycle. The only difference in the two methods under consideration is that with the use of pulverised coal, the major portion of the incombustible content is carried away with the flue gases and deposited at various points, including the external surface of whatever happens to be in the vicinity of the boiler-house stack, and it is quite within the range of possibility that a percentage of unburnt carbon is carried away with the ash, but owing to the inconvenience of collecting samples for analysis from the roofs of the buildings in the locality, it is assumed that the amount of combustible in the ash is a minute quantity.

With the mechanical stoker method of boiler firing, a minor portion of the ash content of the coal is carried away with the flue gas, so small that it may be termed insignificant, the major portion of the ash being formed into clinker and taking the recognised ash route *via* the ash pit; it carries away with it a varying percentage of combustible that becomes entrapped during the formation of clinker in the boiler furnace and is not visible, but is revealed during the testing of the ash and clinker for carbon content.

Any visible carbon that may appear in the ashes is not due to the mechanical stoker as a method of boiler firing, but is due to inefficient operation by those controlling the plant.

The question naturally arises why the ash-handling plant has very little work to do when using pulverised fuel, with the same amount of ash content in the coal. The answer is obvious when taking into consideration that both the combustible and the incombustible are pulverised at the same time, and that separation takes place in the boiler furnace, with the assistance of forced draught; the ash being in a finely powdered state is easily carried away with the gases and deposited anywhere within a radius of a thousand yards of the stack in localities where the external cleanliness of buildings, &c., is a minor consideration and pollution of the atmosphere is ignored, wilfully or otherwise.

Assuming that the operating and upkeep costs are the same with both methods of firing, the numerous claims in support of pulverised coal may be boiled down to one item: "Is pulverised coal burnt more efficiently than coal burnt on a chain-grate stoker?" When both are burnt under the ideal conditions of complete combustion, the answer is obviously No! as the total latent heat of the coal would be liberated in both cases, and would be available for absorption by the heating surface of the boiler in both instances.

This brings into prominence the efficiency of combustion generally denoted by the percentage of CO_2 recorded by the analysis of the flue gases at the last pass; to obtain a high percentage of this product of complete combustion it is necessary to have complete control of the air supply to the furnace, from which it is evident that the type of draught used plays a prominent part in the realisation of maximum efficiency from the boiler furnace as a heat generator.

Forced draught is well known to be far in advance of induced draught for flexibility and fineness of control, and a combination of the two types, known as balanced draught, is ideal compared with either system. The adaptability of pulverised coal to the use of both forced and balanced draught is no doubt the foundation on which claims of higher efficiencies are based, and the whole question resolves itself into the type of draught used. Taking into consideration the fact that the majority of mechanical-stoker-fired boiler plants operate on the induced-draught system with its coarseness of con-

trol, it is very evident that any discrepancies in efficiency that occur are directly due to the method of supplying the necessary amount of air for combustion, and the flexibility of control of the same, proving the superiority of balanced and forced over induced draught. The legitimate conclusion that may be arrived at is that any superiority of pulverised coal firing over mechanical stoking is directly due to the use of forced draught, which fortunately readily lends itself to this method of boiler firing and forms an integral part of the unit, which is the essence of simplicity compared with the application of forced draught to the chain-grate type of mechanical stoker.

It can be safely said that with the same grade of fuel, the same type and control of draught on the same type of boiler, the efficiencies obtained by the two methods of boiler firing would not differ to the extent of allowing one method to be classed as far superior to the other.

More importance would certainly be attached to the comparison of efficiencies obtained by the two methods of firing if tests were carried out in this country by an unbiased engineer.

Automatic Electric Time Switches.

A SERIES of time switches has been introduced by MESSRS. NATHAN & ALLEN, LTD., which presents several interesting features. The switches, which are wholly of Swiss make, are classified as relay clocks, staircase switches, time switches, and remote control switches.

The relay clocks are provided with either a pendulum escapement or a lever movement, and with either hand or electric wind; the cases are of pressed steel, and are dust-proof. The mechanism is of high class, and is stated to keep accurate time, unaffected by variations of temperature. These clocks

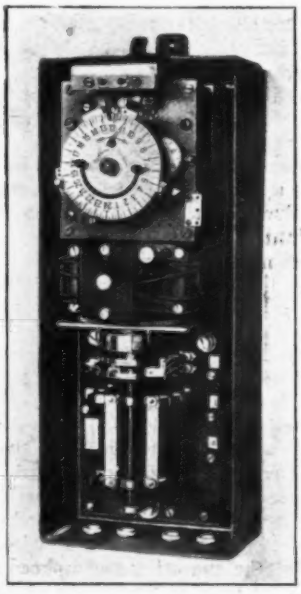


Fig. 1.—Time Switch, with cover removed.

are suitable for use on circuits up to 500 volts, a.c. or d.c., with double-tariff or two-rate meters, switching on or off twice or four times in 24 hours; the switches are of the quick make and break type, without mercury contacts, and can carry continuously 0.6 ampere at 250 volts. The relay clocks can also be used with triple-tariff meters, remote control switches, &c. Automatic staircase switches are made for currents up to 5 A at 250 V a.c., and, besides closing the lighting circuit from dusk to 11 o'clock or other hour, enable persons during the hours of darkness to switch on the lights by pressing push-buttons installed on each floor, the switch in that case opening again automatically after three or four minutes. They are also made for the latter function only.

The time switches are designed to carry currents ranging from 2 to 200 amperes, up to 250 or 500 volts, single, double, or triple pole, and in most patterns are electrically wound. The cases are of iron, and the switches are of the quick-make and quick-break type. A very interesting feature of these switches is the use of a small pilot motor to actuate the contact drum and to wind up the clock daily; this motor is of the same size for all sizes of switch, the power required to operate the larger sizes being obtained by using a higher gear ratio, so that the motor runs for a longer time before sufficient energy is stored up to actuate the switch. The motor is extremely well made, and is very compact; it is suitable for both d.c. and a.c. circuits.

Fig. 1 is a view of a 10-A, 220-V time switch which closes two lighting circuits at dusk, opens one towards midnight, and switches the other off at daybreak. The motor which winds the clock and operates the switch is situated just below the dial, and is shown separately in fig. 2; it consists of a laminated field surrounding a small armature which is mounted horizontally in the case. The bearings are lubricated by grease cups, and a third bearing is provided to support the back end of the spindle; the latter drives the large wheel seen in the illustration through a worm-wheel and pinion. The spindle of the large wheel carries a coupling which winds the operating spring, until sufficient energy has been stored up, when the coupling is automatically released and the switch is thrown.

The spindle of the worm wheel carries a square to wind the clock-spring; the latter is rewound for a fixed number of turns every time the switch operates, a disengaging mechanism ensuring that it shall not be overwound. The brush gear is very neat. We understand that over 30,000 of these motors are at work.

An interesting feature of the device is the astronomical dial, which is simple and robust, and is readily removed from the clock. A view of the back of this dial is given in fig. 3. The worm wheel A is advanced once in each revolution by the star-wheel B engaging with a fixed pin; the worm wheel actuates through link motion the arm C, advancing or retarding the hour of switching-on in accordance with the sinusoidal curve representing the daily variation in the hour of sunset, whilst simultaneously the arm D regulates the time of switching-off at daybreak. Any desired curve can be worked to, but means are provided, by shifting the pin at C into one of the vacant screw holes, to change the time of starting over a range of 90 minutes, and similarly a small range of adjustment—over about half-an-hour—can be made in the position of the vane on D. A third arm, E, not affected by solar variations, controls the hour of cutting-off one circuit, being clamped to the dial at any desired point; a fourth arm may be added if required, and this is in fact the standard practice for ordinary purposes. On the front of the worm-wheel A are marked the months, and the dial is set by turning the star-wheel by hand until the correct date appears opposite a pointer. A pointer fixed over the top of the dial indicates the hour of the day, and for exact time-rating a

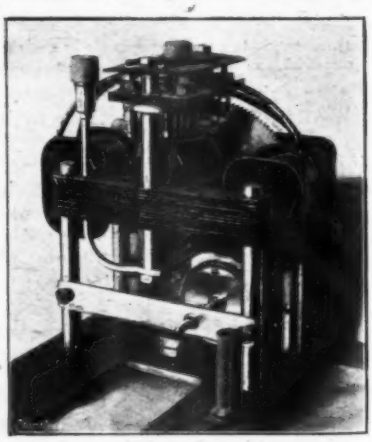


Fig. 2.—Motor and Gearing.

little dial and pointer at the rear of the main dial give the minutes.

Though the switches are electrically wound every day, the clocks will run for three or four days without re-winding in case the supply is cut off for a time, being completely rewound when the current comes on again.

The largest devices here dealt with are automatic high-pressure switches, which are made in two patterns, for pressures up to 3,300 and 6,600 V respectively, and for 25 or 50 A in each case. The time switch employed is of the lever escapement type standardised for the low-pressure switches, and here again the little standard universal motor does all the

heavy work, and winds the clock each time the switch operates. The oil switch is of the latest type, and is contained in a separate compartment, all high-pressure connections being entirely separate from the low-pressure apparatus. The moving contacts are of the laminated-brush type, so arranged that any failure of the mechanism would cause the switch to break circuit, and renewable sparking tips are provided. The switch can be operated by hand independently of the clock

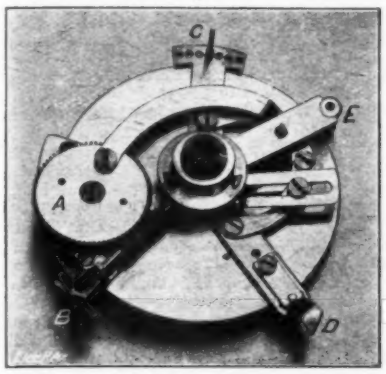


Fig. 3.—Astronomical Dial (back view).

mechanism, and can be locked on or off. The mechanism is positively driven, and is unaffected by vibration.

Messrs. Nathan & Allen, Ltd., also supply remote-control switches without the clocks; these can be controlled by a temperature regulator depending upon the use of a bi-metallic strip, which can be set for temperatures up to 600 deg. F., or by a pressure regulator, actuated by fluid pressure due to a pump or compressor.

Shop Window Lighting.

THE introduction of the gasfilled lamp placed at the disposal of shopkeepers a wonderful means of displaying their goods at night or on dull days. Unfortunately, the majority of shopkeepers did not call in the services of experts to advise them upon the proper use of the lamp, and the result was that the former moderate illumination gave way in many instances to a painful glare. The development of scientific shop-window illumination is of comparatively recent date, but there are indications that the need for a correct lighting system is being more and more appreciated.

Fig. 1.—Messrs. Austin Reed's Premises, Kingsway.

Three excellent examples of shop-window lighting have recently been brought to our notice, and we give particulars and illustrations of these below.

The first (fig. 1) is the work of Messrs. Tyler and Freeman at the premises of Messrs. Austin Reed, in Kingsway. The illumination of the windows is only a part of the lighting system installed by the firm, but it is this that we are concerned with at the moment. It is noteworthy that in this case the architects were consulted and their plans were arranged to accommodate the lighting system in the best possible manner. Fig. 1 is reproduced from an untouched photograph of the windows at night. Even allowing for the values lost in reproduction, it will be seen that the light is very evenly diffused, bringing every article displayed into equal prominence. The installation consists of 60-W "Mazda" gasfilled lamps in B.T.H. "X-Ray" mirror reflectors of the "hood" type, and not a lamp can be seen from the outside.

The second installation is at premises of an entirely different nature—the Holborn furniture shop of Messrs. David Drage and Sons, Ltd. (fig. 2). The equipment employed in this instance is the production of the General Electric Co., Ltd. The usual system of a row of reflectors fitted close to the

Fig. 2.—Messrs. Drage's Premises, Holborn.

ceiling and to the window has been adopted. It consists of about forty "Gecoray" mirror glass reflectors spaced 12 in. apart, wired on two separate circuits. This arrangement permits the full power of the installation or half of it to be used at will, or, alternatively, one-half can be fitted with colour screens, and the rest left clear to give colour-changing effects. This general lighting is supplemented by five window-floodlights and five spotlights to permit of any particular article in the window being given extra prominence. A time-switching system has been adopted for "after-hours" lighting.

The third installation is also the General Electric Co.'s work. The problem presented, that of lighting a mass of flowers, probably involves more difficulties than either of the foregoing instances, but it appears from the illustration (fig. 3) to have been successfully solved. The window is

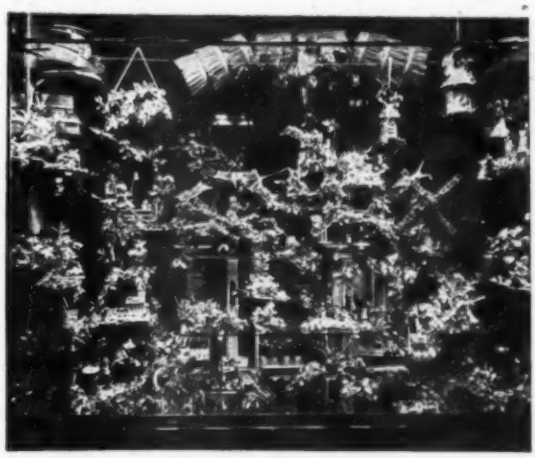


Fig. 3.—Messrs. Goodyear's Premises, Royal Arcade, Old Bond Street.

that of Messrs. Goodyear, florists, Royal Arcade, Old Bond Street. An outstanding feature of this example is the black background which throws up the exhibits in a bold relief.

Church Loud-Speakers.—At Westminster Abbey on Easter Sunday the voice of the preacher was amplified and reproduced by special loud-speakers installed by the Western Electric Co., and the sermon could be heard with the greatest ease in every part of the great building. It is expected that the loud-speakers will be a permanent installation in the Abbey, and similar devices will probably be used also in St. Paul's and other cathedrals.

Pulverised Coal.

By G. P. DENNIS, M.I.E.E.

(*Abstract of paper read before the* LIVERPOOL ENGINEERING SOCIETY.)

COAL economy is undoubtedly vital to this country. It is, therefore, of the utmost importance that British engineers should give this comparatively new system of coal burning their serious consideration. If (taking the figures given by the Coal Conservation Sub-Committee in 1913) 189,000,000 tons of coal were used in Great Britain per annum; if 10 per cent. (which is 18,900,000 tons) could be saved, and this could very easily be done, it would represent £28,350,000 at 30s. per ton. The author estimates that 90,000,000 tons are used for steam raising only and a 10 per cent. saving would show economy to the value of £13,500,000. The question of smoke abatement is successfully solved by burning coal in a pulverised form.

The author would particularly draw the attention of marine engineers to the great advantages to be derived from powdered fuel for steam raising on board ship. Oil fluctuates sharply in price as demand increases, and is in the hands of huge trusts. Coal, on the other hand, is much more stable in price, and can be obtained in all parts of the globe, which is of great importance to the marine engineer. To obtain the greatest efficiency out of coal it is necessary to pulverise it, and with suitable plant, a smokeless fire with a steady intense heat and maximum furnace temperature can be obtained. The breaking of the coal into minute particles increases enormously the surface area exposed to the air in which it burns. Owing to the intimate mixture of air with the coal particles, only twenty per cent. of excess air is necessary above theoretical values. Therefore, complete combustion is obtained with about 16-18 per cent. CO_2 and no CO is found in the flue gases. In mechanical stoker practice 50-60 per cent. of excess air is considered good, and the best figures for CO_2 are 14-16 per cent. The boiler efficiency has been raised to 80-85 per cent. in powdered fuel plant.

Pulverised fuel burners appear to have a very great future, for when once set for a particular class of coal, they will continue under the very best possible conditions, always giving the boiler its maximum efficiency. Change in fuel is easily and quickly adjusted, and fluctuations in load are met more easily than in any other system. There is no trouble in coping with sudden overloads. In the "Buell" system the control of boiler pressure can be made automatic by means of an electrical arrangement regulating the speed of the motor which feeds the air and fuel. On moderate-sized land boilers and in marine practice, the future appears most favourable for pulverised fuel plant of the Unit type, which is described in detail in the paper.

Not only have the difficulties of burning high-grade bituminous coal been overcome, but low-grade fuels containing high percentages of ash and sulphur have been successfully burnt. In addition, the brown, soft, coal (lignite) of Australia, which is practically the same as West African coal from the Udi district, has been burned under all classes of boilers with remarkable efficiencies. Pulverised fuel plant is now as reliable as the mechanical stoker.

When considering the two main types of boilers, *viz.*, internally and externally fired, it is of the utmost importance that special consideration be given to the cubical contents of the combustion chamber; a particular burner working with a certain air pressure may be quite suitable for an externally-fired boiler, but will be quite unsuitable for those internally fired. There are three types of burners, *viz.*: (1) Those which give a long, round flame and are not capable of adjustment when working; (2) those which resemble No. 1, only the flame is fanned out flat instead of being round; (3) those in which the flame can be made very short, expands immediately on leaving the burner, and is capable of adjustment as to length, area, and direction without shutting down the burner.

No. 3 is the type particularly suited for use in Lancashire, Cornish, and marine boilers. The combustion of the fuel begins at the nozzle of the burner and the flame completely fills the whole of the furnace in its entire length, thus utilising every cubic foot of space for combustion, whereas with No. 1 the front end of the furnace tube is not utilised owing to the shape of the flame being longer and not reaching the sides of the furnace until it has travelled some distance, thereby reducing the surface directly heated by the flame. With the latter type it is necessary to build a suitably proportioned external furnace.

In America, the majority of engineers have specialised on the development of the indirect system, suitable for large electric power stations, and in a few examples for large iron works, for annealing, puddling, copper and tin smelting and other such furnaces. The large capital outlay for experimental research makes this prohibitive in a number of cases. There is little doubt that much greater progress will be made now that the simple direct or Unit system is perfected. This consists of a crusher and conveyor to the pulveriser whence the fuel is floated away by a fan which blows it directly into the burner. The plant is simple, occupies little space, and its cost is very moderate. Each furnace is independent of the others, and the failure of one does not materially affect the output of the remaining boilers, for it is a very simple matter to increase the capacity of the other furnaces by speeding up their respective pulverisers. Referring to the "Buell" unit system, the coal (where it cannot be bought as slack or under 1¼-in. cube) is crushed and put into the pulveriser, and hot air is taken from the combustion chamber and passed through the pulveriser; this not only supplies hot air for the burner, but also dries the fuel, which may be heated up to 300 or 400 deg. F. The efficiency of the plant is considerably increased by this method, and the drying of the coal aids pulverisation very much; as a matter of fact, experience shows that fuel should not contain more than from 4 to 5 per cent. of moisture; but coal has been pulverised and burned on the Unit system with remarkable success, with from 10 to 15 per cent. of moisture. The fan induces a current of air through the pulveriser to separate the coal dust. The amount of air is regulated to determine the fineness of the coal. The coal dust does not pass through the fan, thus avoiding great wear on the fan blades which adds to upkeep cost and stoppage. The current of air conveys the powdered fuel into the burner.

This machine is of the "Milloyd" roller type, and the power required to drive it is very low; further, the renewals are negligible.

The Fuller Lehigh pulveriser mill illustrates the ball type, which has considerable popularity. Dry coal is fed to the mill from an overhead bin by means of an adjustable screen. The feed is regulated by two cone pulleys when the screen type feeder is used. Grinding is accomplished by the centrifugal and gravity pressure exerted by four unattached metal balls rolling against the hardened face of a stationary horizontal concave-shaped grinding wheel. The balls are propelled around the ring by means of four pushers attached to four equidistant horizontal arms radiating from a yoke which is keyed directly to the mill shaft. As the material falls between the grinding rings and the balls, it is reduced to the desired fineness in one operation. The pulverised product is lifted from the grinding zone into the separating chamber by an upper fan and a second fan acts as an exhauster and draws the finely divided particles from the separating chamber through the finishing screen. This machine is very substantial; no parts of the frame are subject to wear from the grinding element or any moving part of the mill. New rings can be inserted in less than two hours.

The "Buell" ordinary burner gives a long flame which can, within limits, be expanded. It is suitable for furnaces and kilns which are relatively long. The control of air can be varied instantly, which is a desirable feature if coals of differing calorific qualities are being used. The dispersive burner gives a shorter flame, and is especially suitable for boiler work where low velocities are required, and where combustion must be completed entirely in the fire box and only hot gases enter the tubes and flues. If an ordinary open pipe is used as a burner the stream of dust cannot possibly mix with the air, and before it can be entirely consumed the unburnt carbon passes into the tubes and there is a loss of efficiency. If, on the other hand, the cloud of fuel is opened out fanwise by means of baffles, there is an impingement of the fuel on the walls of the fire box, and the sandblast action erodes the lining. The problem, then, is to open out the fuel cloud, thoroughly mix it with the air, and then to gather it together, so that it leaves the burner in almost parallel lines, with an increased diameter so that the entire combustion space is filled with a non-scouring flame. This problem has been successfully solved by the "Buell" dispersive burner.

The "Buell" system was installed in Melbourne in the first instance to burn lignite under four Babcock & Wilcox boilers with a total normal capacity of 1,425 h.p. The boilers may be over-loaded by 100 per cent., the steam is superheated 160 deg. F. The brown coal is crushed at the mine to pass through a 1¼-in. mesh, and is conveyed to an air-drying bunker with a capacity of 1,000 tons. The coal remains in the bunkers for from 7 to 10 days, and the moisture content is reduced from 50 to 35 per cent. The efficiency of the air drying, of course, depends entirely upon the state of the weather. Belt conveyors take the coal from the bunkers to an artificial heat dryer of the indirect type, where the hot gases do not come in contact with the coal. Care is taken to keep the coal as near 10 per cent. moisture content as possible.

The dried brown coal is loaded into open trucks, covered with tarpaulins, and sent to the generating station for pulverising. The trucks are unloaded by means of a pneumatic conveyor into storage bins. About 50 cu. ft. of air has to be carried for every cubic foot of coal. The fuel and coal

are separated at the bunker end by means of a cyclone separator.

A belt conveyor running over a magnetic pulley which separates the tramp iron, carries the coal from the storage bins and delivers it to the pulverising bin. The pulveriser reduces the coal to 120 mesh, and a separating fan delivers the dust to a cyclone on top of the storage bin, into which the fuel drops by gravity and the air is returned to the mill. The delivery of the fuel to the bunkers in the boiler room is done by compressed air. The coal drops from the storage bunker by gravity into a cylindrically-shaped steel blowing tank, balanced upon recording scales. Switch valves in the delivery pipe at each off-take from the main line to the several storage bunkers in the boiler room are operated by the boiler attendant. By an ingenious arrangement one valve is always left open so that the line cannot be clogged. By this system one ton of the pulverised coal is transported 500 ft. in five minutes. Whenever a bunker at the boilers wants replenishing, the gate in the storage pulverised fuel bunker is opened and five tons of fuel flows into the blowing tank. During this operation a sleeve around the delivery pipe within the tank is down, and there is no possible escape for the coal. When the operator has noted the weight of the coal he turns on the compressed air into the vacant space within the tank above the coal. When the pressure has reached about 70 lb. per sq. in., the air is turned off and the sleeve raised. This allows the powdered coal to blow upwards through the delivery pipe to any desired bunker. Coal can be made to flow like water.

By comparing the feed water flow with the fuel flow, adjustments may be made to obtain the best results. Each boiler is provided with secondary superheating air ducts, which pass back and forth through the side settings and bridge wall, thus raising the temperature of the air passing through the ducts by several hundred degrees. Steam induction jets are inserted in the inlet of these ducts to increase the velocity of the air passing through. A slagging chamber deals with the slag and clinkers that would be produced if bituminous coal was used. Brown coal gives very little slag. There is nothing more important when burning pulverised coal than to keep the tubes clean from deposits of ash or soot. In this case a " Diamond " blower is employed.

It is estimated that 90 per cent. of the world's output of Portland cement is fired by pulverised coal. The Ship Canal Portland Cement Manufacturers, Ltd., Ellesmere Port, reports as follows :—" We have tested the ' Buell ' burner, and under the conditions at our works we are of the opinion that this burner is an advance on any burner we have previously tried."

The Unit system is undoubtedly the ideal for ships. The most economical arrangement is one pulveriser for each boiler end. It gives great flexibility and safety against breakdown. The motive power for driving the crushers, pulverisers, and fans can be supplied by means of small turbines, reciprocating engines, or electric motors. The most efficient is the electrical system, using turbines or high-speed engines for driving compound-wound generators and totally-enclosed motors for driving the machines. There is an approximate saving on pulverised coal at 28s. over oil of 83.5 per cent.; pulverised coal at 15s. over oil of 215 per cent.; and pulverised coal at 28s. over hand-firing of 52 per cent., when 100 per cent. efficiency is allowed for oil and pulverised coal, and 75 per cent. for hand-firing.

The above figures will show that pulverised coal for marine work will undoubtedly take a prominent place.

The following are some of the claims made for this system : Boilers always under best conditions, less excess air, no loss due to cleaning fires, &c. The unburnt fuel in the ash will be about 0.5 per cent. against from 5 to 10 per cent. for hand or machine firing. Considerable overloads can be maintained, which reduces boiler plant and gives increased space.

There is very little danger of explosion, but, of course, there is a little more than for hand or mechanical stoking. Repairs on the machinery part are about the same as for machine firing, but pulverised fuel is not so severe on the brick linings.

The power consumed varies between 8 and 20 kW per ton per hour, depending on the type of pulveriser; 20 kW is about 1 per cent. of the steam output, and mechanical stokers take 1 to 3 per cent. Constant boiler pressures can be obtained automatically. Stand-by and banking losses are greatly diminished with pulverised coal. No difficulty is found in obtaining smokeless condition. Very small fuel of same calorific value as large lumps can be used, which could not be worked by hand or chain grates.

Chinese Inactivity.—Purchases of electrical equipment by Chinese mills, railways, and lighting plants are not being extensively made under present conditions, according to the United States Trade Commissioner at Shanghai. Some re-equipment business is expected to be placed, but until capital can be safely invested and general business conditions improve to a point where present industries are in a position to pay dividends the outlook for new business in electrical apparatus lines is not encouraging. British, Swiss, and German competition in electrical equipment is keen.

Trade Statistics of Egypt.

The following statement, showing the imports of electrical and similar goods into Egypt during the year 1923, is taken from the recently-issued trade statistics. The figures for 1922 are added for purposes of comparison, and notes of any increases or decreases are given :—

	1922 £E	1923 £E	Inc. or dec. £E
Steam engines, stationary.—			
Total	2,000	—	– 2,000
Electrical machinery and parts.—			
Total	196,000	144,000	–52,000
From Great Britain	52,000	26,000	–26,000
,, United States	1,000	10,000	+ 9,000
,, France	104,000	48,000	–56,000
,, Italy	6,000	26,000	+20,000
,, Switzerland	14,000	13,000	– 1,000
Internal combustion engines, stationary.—			
Total	222,000	255,000	+33,000
From Great Britain	71,000	147,000	+76,000
,, France	2,000	1,000	– 1,000
,, Italy	2,000	1,000	– 1,000
,, Switzerland	77,000	55,000	–22,000
,, Germany	52,000	49,000	– 3,000
Electric light bulbs.—			
Total	53,000	44,000	– 9,000
,, Great Britain	2,000	1,000	– 1,000
,, Germany	9,000	8,000	– 1,000
,, France	1,000	1,000	—
,, Italy	1,000	2,000	+ 1,000
,, Holland	23,000	18,000	– 5,000
,, Switzerland	1,000	1,000	—
,, Czecho-Slovakia	2,000	6,000	+ 4,000
,, Austria	10,000	6,000	– 4,000
Electric lamps, arc.—			
Total	10,000	—	–10,000
Carbon rods for arc lamps.—			
Total	1,000	1,000	—
Electric cars and wagons.—			
Total	3,000	13,000	+10,000
From United Kingdom	1,000	2,000	+ 1,000
Telegraphic and telephonic apparatus and fittings.—			
Total	73,000	33,000	–40,000
From Great Britain	58,000	25,000	–33,000
,, France	2,000	2,000	—
,, Sweden	12,000	5,000	– 7,000
Meters, electric, gas and water.—			
Total	38,000	27,000	–11,000
From Great Britain	6,000	—	– 6,000
,, France	26,000	22,000	+ 4,000
,, United States	1,000	—	– 1,000
,, Germany	4,000	4,000	—
Electric and gas pendants.—			
Total	48,000	43,000	– 5,000
From Great Britain	2,000	2,000	—
,, France	18,000	13,000	– 5,000
,, Germany	16,000	17,000	+ 1,000
,, Italy	3,000	7,000	+ 4,000
Other electrical appliances and batteries.—			
Total	29,000	51,000	+ 22,000
From Great Britain	3,000	11,000	+ 8,000
,, Austria	2,000	2,000	—
,, Belgium	1,000	—	– 1,000
,, France	3,000	6,000	+ 3,000
,, Germany	13,000	21,000	+ 8,000
,, Italy	4,000	7,000	+ 3,000
,, Switzerland	1,000	1,000	—
,, United States	2,000	2,000	—
Electric cables, insulated.—			
Total	80,000	68,000	–12,000
From Great Britain	18,000	12,000	– 6,000
,, Belgium	4,000	5,000	+ 1,000
,, France	31,000	29,000	– 2,000
,, Germany	16,000	13,000	– 3,000
,, Italy	5,000	4,000	– 1,000
,, Japan	1,000	—	– 1,000
,, United States	1,000	1,000	—
Uninsulated electric copper wire.—			
Total	15,000	20,000	+ 5,000
From Great Britain	7,000	7,000	—
,, France	8,000	10,000	+ 2,000
Electric light fittings.—			
Total	93,000	70,000	–23,000
From Great Britain	14,000	9,000	– 5,000
,, Belgium	2,000	1,000	– 1,000
,, France	16,000	14,000	– 2,000
,, Germany	42,000	29,000	–13,000
,, Italy	5,000	5,000	—
,, Switzerland	3,000	4,000	+ 1,000
,, United States	4,000	3,000	– 1,000

£E = £1 0s. 6½d.

Electricity Districts.

East Midlands Order.

THE East Midlands Electricity District Order, 1924, made by the Electricity Commissioners and confirmed by the Minister of Transport under Section 7 of the Electricity (Supply) Act, 1919, constituting the East Midlands Electricity District and establishing an Advisory Board for the area, has been issued, and will become operative as soon as it has been approved by both Houses of Parliament.

It will be remembered that an amended scheme for the reorganisation of the supply of electricity in the area was outlined in our issue of January 12th, 1923, and the Commissioners' local inquiry relative thereto was reported in our issue of July 20th last year.

An Engineers' Committee is to be set up, and for generation the standard type of current will be 3-phase, 50-cycle, a.c., while for transmission the standard pressure (between phases) is to be, in the case of main transmission lines, 33,000 volts, and in the case of secondary transmission lines, 11,000 and 6,600 volts.

The following generating stations will be utilised under the scheme and extended as may hereafter be determined:—Freeman's Meadow (Leicester Corporation); North Wilford (Nottingham Corporation); Spondon (Derbyshire and Nottinghamshire Electric Power Co.); Burton (Burton Corporation); Derby (Derby Corporation). The following stations will be utilised until the load can be transferred to the new stations belonging to the same undertakers:—Lero and Aylestone (Leicester Corporation); Talbot Street, St. Anne's Well Road, and the temporary station at North Wilford (Nottingham Corporation).

The following stations will be utilised until such time as other supplies become available at rates justifying the shutting down of the stations in question, *i.e.*, those owned by Long Eaton Urban District Council, Loughborough Corporation, Mansfield Corporation, and Melton Mowbray Electric Light Co., Ltd.

A scheme of main transmission lines is to be prepared by the Board and submitted to the Commissioners for connecting *inter alia* the generating stations at Leicester (Freeman's Meadow), North Wilford and Spondon with Burton-upon-Trent, Coalville, Derby, Heanor, Long Eaton, Loughborough, and Mansfield. Provision is to be made during the first stage of development for the requirements of the Newark area as may be determined by the Commissioners.

A scheme for the control of generating stations in the district when interconnected is to be prepared by the Advisory Board, and provision is to be made for the utilisation of the supply of electricity from the generating station of the Leicestershire and Warwickshire Electric Power Co., situate at Hinckley, outside the district.

West of Scotland Inquiry.

The Electricity Commissioners' first inquiry into the scheme submitted by a conference of local authorities for improving the existing organisation for the supply of electricity in the provisionally delimited West of Scotland Electricity District, and for the establishment of an Advisory Board for the area, was commenced at Glasgow on April 23rd. It will be recalled that 17 authorities in the area interested in the production of electricity combined, following agreement in conference, to support the constitution of a comprehensive supply district under the jurisdiction of a co-ordinating authority in the form of an Advisory Board.* Two authorities withheld acquiescence—the Corporations of Glasgow and Greenock. Glasgow took the view that the city should be treated as a separate supply district in itself, while Greenock objected to the establishment of an Advisory Board, maintaining that it was preferable to set up a joint administrative board. Glasgow also maintained that the scheme failed to take cognisance of the project which the Corporation contemplates of establishing another large generating station.

The promoters of the conference scheme made representations to the Commission that the area originally defined should be extended so as to include, with Glasgow and Renfrewshire, practically the whole of the counties of Ayr, Dumbarton, and Lanark, and also penetrations into Stirlingshire, and into a few Lothian parishes contiguous to Lanarkshire.

The Commissioners conducting the inquiry were:—Sir John F. C. Snell (chairman), Sir Harry Haward, Mr. H. Booth, accompanied by Mr. E. W. Hudson as legal adviser, and Mr. D. S. Cumberlege. The promoters were represented by Mr. Rowand Harker, and the Corporation of Glasgow by Mr. T. Graham Robertson, K.C., and Mr. G. A. Montgomery, while other interested parties were also legally represented.

Mr. HARKER, in explaining the proposals, pointed out that the promoters numbered 17, consisting of 13 local authorities, the Clyde Valley Electrical Co., and three electricity supply companies. The local authorities promoting the scheme were the county of Renfrew, the burghs of Paisley and Kilmarnock, the county of Dumbarton, the burghs of Dumbarton and Kirkintilloch, the county of Lanark, and the burghs of Lanark, Hamilton, and Motherwell and Wishaw, the county of Stirling, and the companies. That list, he claimed, was thoroughly representative of the various undertakings in the proposed electricity district. There were, however, some omissions in the list, the most important of which were the Corporations of Glasgow and Greenock.

If the proposal were sanctioned, it would result in considerable advantage to manufacturers and other consumers by enabling them to get their supplies at lower prices; while it would also assist in the conservation of coal. These advantages could only be obtained by co-operation, and he was glad to say that that spirit very largely existed in the West of Scotland District they proposed to form. Glasgow stood in a position of isolation, but he hoped that one result of the inquiry would be that the most important Corporation, from civic and electrical points of view, would see its way to recede from that position and give its counsel and advice to the proposed Advisory Board.

There was, Mr. Harker reminded the Commissioners, only one scheme before them, and they had either to accept it, with such amendments as they thought fit to make, or, if they did not do so, they might formulate a scheme of their own. The body to be set up in the district ought to be, they contended, an Advisory Board and not a Joint Electricity Authority. Greenock was the only authority which still objected to the setting up of the Board, and persisted in asking for the formation of a Joint Electricity Authority.

It was not suggested that there was in that district scope for great economies by the setting up of the Board, but there was scope for some economies, and, what was of importance, there was scope for giving additional security of supply. Certain stations should be shut down, and other stations would be used, but not extended; while the main generating stations would be extended up to their ultimate capacity; and in lieu of the stations closed there would be constructed a number of special transmission lines.

Mr. A. M. MACROBERT, K.C., explained the position of Clydebank Town Council, which had an Electric Lighting Order, but under an agreement the supply of energy was obtained from the Clyde Valley Co. There would be a break in the agreement next year, and the Town Council could exercise its power. At present Clydebank was not one of the constituent parties, but it desired representation on the Advisory Board. If that were given, it would withdraw its objections.

It was intimated that arrangements would be made for Clydebank's representation on the Advisory Board.

Evidence was then led in favour of the promoters' scheme, and the first witness examined was Mr. BRYCE WALKER, joint clerk to the County Council of Lanark.

In answer to Mr. GRAHAM ROBERTSON, the witness agreed that it was correct to state that throughout the negotiations Glasgow had done everything, so far as the providing of statistics was concerned, to help in the matter, and only withdrew when it discovered that objections which it considered vital could not be overcome. He was aware of the fact that the Corporation of Glasgow was negotiating for land to the west of the city, but he did not associate that at the time with the erection of a new power station.

Asked what benefit was to be derived by Glasgow from inclusion in the scheme, witness replied that it would be a party to a body covering the whole area, and it might at some time be of great benefit to it.

Captain ALLAN BURNS, convener of the county of Dumbarton, and Sir HUGH SHAW STEWART, Bart., convener of the county of Renfrew, also gave evidence. The latter stated that the Renfrewshire Council was satisfied with the scheme as it stood, but if any material alterations were made in the allocation of representatives on the Advisory Board, it desired to be able to reconsider the position.

When the inquiry was resumed on April 24th, Mr. ERNEST T. GOSLIN, M.I.E.E., general manager of the Clyde Valley Electrical Co., was examined by Mr. Harker. Mr. Goslin explained the circumstances that had induced his company to apply to the Government for the proposed powers in its Bill. From time to time, he stated, the company had applications for electricity for lighting purposes from persons whose premises were in close proximity to the company's mains. They could not understand why the company was unable to supply them. Many did not believe them when told it had no power to supply them. The mains might be passing their very doors, yet it had no legal right to supply them. There were no petitions against the domestic lighting clauses of the Bill. According to estimates prepared by the Engineering Committee, the capital expenditure under the proposed scheme would be £1,172,820, whereas the cost of individual development would be £1,226,000, representing a saving in capital expenditure of £53,000. Administrative expenses of the Advisory Board were estimated at £1,000 per annum.

Referring to the position of the Glasgow Corporation, he said if it came in it would help to promote the efficiency of the scheme. Cross-examined, witness agreed that Glasgow was most decidedly looking after its own electrical interests.

* ELECTRICAL REVIEW, February 29th, 1924.

Regarding the proposal that the Pinkston station (which is entirely devoted to tramway purposes) should not be extended, witness said it was a domestic question for Glasgow alone. He was aware that the Glasgow Corporation was considering that station.

MR. GRAHAM ROBERTSON: Glasgow has advocated that recognition should be given to the fact that she intends to erect and equip a large capital station immediately to the west of the city to provide for future requirements. Witness thought that was a matter that should be raised before the Advisory Board. He agreed that there would be no saving to the municipality under the proposed scheme.

The CHAIRMAN: This scheme of yours shows an ultimate saving, as compared with individual development, of some thousands a year. Is that really in your view the greatest improvement that can be brought about in this district?—Witness: It is the biggest improvement we can show on paper. —The Chairman: In the proposals for your scheme one is naturally surprised to find that your deliberations only mean an apparent saving of £23,000 a year, which suggests that development in the Clyde area and in Glasgow is already of such a nature that very little improvement can be added to the existing improvement? Witness agreed.—The Chairman: Do you seriously contemplate that all the energy which is to be generated in this district is going to be produced by fuel? —Witness: The problem has not been seriously considered. The Chairman: At a time of rapid advance in the application of electricity, is it not in the interests of your clients, whether a corporation or private clients, to consider the possibilities of the utilisation of the important water powers which may be, and personally I believe are, available?—Witness: The Grampians Electrical Power Co. has a very big area and has already approached us as to whether we would be prepared to take energy from it. My answer was: Yes, if it could give it as cheaply as we could make it ourselves.

THE CHAIRMAN expressed the view that it would be a national loss to Scotland if the available and important water power in Scotland were not economically developed and utilised. He suggested that the promoters were looking at the matter too much from their own individual standpoint rather than from the broader point of view, which might bring about much bigger and better results and advantages than their scheme at present showed.

Evidence was next given by MR. ROBERT ROBERTSON, M.Inst.C.E., a director of the Clyde Valley Electrical Power Co., who thought it was premature to insert a clause in the scheme as to the Glasgow Corporation's intention to erect in the future a new power station.

This concluded the case for the promoters.

MR. A. L. MCCLURE, K.C. (on behalf of the Ayrshire Joint Board), stated that the desire of his clients was that there should be two separate Advisory Boards for this particular district, one for the 25 and the other for the 50-cycle area. "There is no reason why we should be compelled to join this polyglot body," remarked Mr. McClure. They wanted a small board of their own to operate the scheme in a sensible way.

The case for Glasgow Corporation opened with evidence by MR. CHARLES H. MERZ, consulting engineer. In answer to Mr. Graham Robertson, he stated that the Corporation would require to have a new station in operation within about eight years even if it filled up Dalmarnock to its full site capacity. In his view it would be expedient and right engineering policy from every point of view to proceed with the new station before filling up Dalmarnock. His advice to the Corporation had been to make provision now. An application to the Commissioners to erect the new station should be very shortly put forward as prudent provision for the near future. The proposed site on the west of the city was as favourable as could be got in the neighbourhood. This new station was in very definite contemplation, and the clause which the Corporation suggested should be put in the scheme was entirely justified by the circumstances in which Glasgow was now placed. He could not see what objection there was to it from the point of view of the scheme. If the Corporation did not erect the station, Glasgow would have to take supplies in bulk from some other persons who erected the station within the next few years. As Glasgow was willing and able to erect the station, witness saw no reason why the clause should not go into the scheme.

Asked if it was his view that if recognition was not given of the right of Glasgow to erect a new station to the west of the city it would not be advisable for Glasgow to participate in the Joint Board, Mr. MERZ replied that he did not see that it could assent to the scheme in any way unless that was specifically stated.

Cross-examined by Mr. HARKER for the promoters, witness said the Corporation feared that in the event of the application coming before the Advisory Board, after it was set up, its case might be prejudiced. He had never heard that the Corporation intended to seek powers to supply electricity to customers outwith the city area. At present the Corporation had no power to do so, but he imagined such powers could be obtained from the Commissioners.

THE CHAIRMAN questioned witness at length regarding the commercial success or failure of the standardisation of a supply of electricity. It was a very big question, said witness, and one that was commercially impracticable at present. The longer they had the two frequency systems maintained and developed separately, the more did the chance of securing standardisation of supply recede. Standardisation was, however, a desirable thing if it could be attained, and it ought to be a matter for serious inquiry by the technical advisers in the scheme.

Answering the chairman further, witness said there was *prima facie* evidence that there were water powers of great size within from 70 to 80 miles of the centre of the industrial district they were considering, and he agreed that on the assumption that such water power could be developed commercially, the persons responsible for the administration of that industrial district ought to seriously consider the application of such power and the transmission of the energy from the water power sites to the district.

COUNCILLOR W. B. SMITH, a member of Glasgow Corporation Electricity Committee for 18 years, explained that Glasgow withdrew from the scheme because of the rejection of some vital amendments. The capital expenditure of the Electricity Department up to May 31st, 1923, was £6,871,000. The undertaking had increased progressively from year to year, and the average for the last ten years was 13 per cent., while for the year ending December last, notwithstanding bad trade, the increase was 17 per cent. There was no financial benefit for the Corporation in the scheme so far as they could see, but the Corporation would be called upon to bear a large share of the expenses of the scheme. The exclusion of Glasgow from the scheme would not, in his opinion, prejudice it. To meet the increasing demand for electricity, it would be necessary for the Corporation to proceed with the erection of a capital station and the Town Council was negotiating for a site. He could not understand the basis upon which it had been calculated that the Corporation should have three representatives on the Advisory Board. In his opinion, on the basis of population, kWh generated, responsibility, or capital invested, the representation of the Corporation should be 50 per cent.

Cross-examined, witness denied that the Corporation had declined to join the scheme because the proposed Advisory Board would not be formed in accordance with its view. Replying to the Chairman, witness said the Corporation had not considered the utilisation of water power, but he thought it would be prepared to join in any investigation.

Answering Mr. Harker, Mr. Smith admitted that at the present stage the Corporation could not demand a right to erect a new station. If a clause were inserted in the scheme to the effect that the new station "will be erected as and when required by the Corporation," it would meet their case.

At this stage the CHAIRMAN announced that it had been suggested to the Commissioners that an arrangement might be come to which would remove some of the difficulties of the city of Glasgow, and the inquiry was adjourned so that the parties could consult together.

On the resumption Mr. HARKER, for the promoters, said they had not been able to arrive at a complete agreement.

SIR JOHN SNELL, the Chairman, suggested that the parties should confer at the conclusion of the inquiry and try to get an agreed clause. Failing that, the matter must be left to the Commissioners, whose suggestions would be considered by the parties at a second inquiry, if that were necessary.

Evidence by Mr. R. B. MITCHELL, the Corporation electrical engineer, closed the Corporation's case.

MR. COOPER, advocate, for Greenock Corporation, said that in view of the fact that the proposed district was divided into a 50-cycle area and the other a 25-cycle area, they suggested that they should remain separate, at least so long as interconnection electrically was not possible. So far as the 50-cycle area was concerned—broadly the district of which Greenock, Kilmarnock and Ayr were the chief centres—the scheme held out no advantages.

Counsel for the Ayrshire Joint Board pointed out that the two areas referred to were geographically distinct, and the electricity generated was different in character.

MR. COOPER, representing the Lanarkshire Tramways Co., whose generating station at Motherwell, the scheme proposed, should be closed down, contended that the initiative for that step should be in the hands of the Commission and not of the Advisory Board.

The inquiry was then closed.

On April 24th the Commissioners visited the Glasgow Corporation power station at Dalmarnock.

The Protection of Hoists.—An interesting pamphlet with this title (Safety Pamphlet No. 2; third edition. H.M. Stationery Office, price 4d. net), has been issued by the Home Office, in which are set out in brief the chief dangers to be guarded against in the use of hoists such as are generally found in factories and warehouses, and the best methods by which this can be done. Several devices are illustrated and described which are intended automatically to prevent accidents, including electrical and mechanical interlocks, and many wise directions are given regarding the design and construction of the cages and mechanism, but chief stress is laid on the importance of regular inspection, without which the best precautions are liable to become ineffective.

New Steel Works in Brazil.—It is announced that the new iron and steel works which are being established in the Doce River valley in the State of Minas Geraes, Brazil, will be electrically operated.

The Faraday Medal.

Presentation to Dr. S. Z. de Ferranti.

AT the meeting of the Institution of Electrical Engineers on Thursday, April 24th, the Faraday medal was presented to Dr. S. Z. de Ferranti, a past president.

COL. R. E. CROMPTON said that in the early days when electrical beginners were looked upon as showmen and their main work was to go about with portable apparatus to show off the electric-arc light, one set of such apparatus was at the Alexandra Palace and a young man was very much interested in it. That young man was Ferranti. The next time he heard of him, both Ferranti and himself were trying to persuade the English public that there was such a thing as electric light. Ferranti had that power of persuasion which followed from a belief in himself and in what he could do. He succeeded to a certain extent, and he also believed that he (Col. Crompton) succeeded to a certain extent. Each started on his own line and for a long time they were considered terrible rivals. They were not; they were always firm friends because they knew the real difficulties—difficulties of finance. It was impossible for people nowadays to appreciate what those difficulties were, quite apart from the troubles of the practical side. In his subsequent work Ferranti had taken the place of two men, for whereas he (Col. Crompton) had had the assistance of that genius Willans with regard to the steam generation side, Ferranti worked alone, did his steam work himself, and solved his own problems. He was also the first to conceive the idea of the capital station and of putting the generating station in the most perfect position as regarded facilities for condensing water and so on. Meantime he, personally, was still trying to help people to use electric light; he was still the showman. Anyway, both Ferranti and himself had their uses. Ferranti was both a steam and an electrical engineer because he not only worked out the steam problems, but also the problems of high-pressure cables and high-pressure generating plant.

MR. G. W. PARTRIDGE said he had always stated that Ferranti had never received that recognition that he ought to have had for his stupendous work 30 or 35 years ago. He felt himself fortunate in having been associated with Ferranti in those early days and no one knew better than himself the difficulties that had to be met. It was said by many at the time that Ferranti was 20 years ahead of his time and that nothing would come of his inventions, but if they compared Ferranti's work of 30 years ago with the most modern practice, they all must be proud of the fact that Ferranti belonged to this country. In 1886 Ferranti first saw the advantage of running transformers in parallel, thereby making the alternating-current system self-regulating. In those early days referred to by Col. Crompton the voltage was 100 and in some cases 200 at the most and small stations were supplying small areas. Then Ferranti conceived the idea of the capital station outside the actual area of supply, and of placing the station on the river where there was an ample supply of water for condensing purposes, room for extension, and no chance of being injuncted for a nuisance. In doing that, however, it became necessary to increase the voltage to 10,000. Just imagine what that meant in those days? The scheme which Ferranti prepared involved the design of practically every detail from the engine to the meters because there were no a.c. meters in those days. Current was sold at so much per lamp. "I wish we could do it now." Ferranti designed his generators 10 times as large as anything then in existence; his problem could be compared with that of the consulting engineer to-day, who merely had to sit down and state what he wanted in a specification and would have contractors falling over one another to get the job and, incidentally, to place the whole of their technical staff at the disposal of the consulting engineer. Ferranti had no contractor to rely upon and he had to design every single detail himself. There was one more example of his genius and courage. Having got his generating station to work at 10,000 volts, he found that the cables which had been made by an outside contractor were quite inadequate to run at that pressure and they broke down continually. Ferranti immediately set to work to design his own paper-insulated cables, 14 miles of which were to-day in actual use at a pressure of 11,000 volts. What did they find to-day? In the most up-to-date practice, whether for high- or low-pressure cables, the insulation was paper, exactly the same as Ferranti used in those early cables. He had just returned from abroad and had been talking to a well-known engineer about the work done in those early days who had said: "Ferranti must be a very old man by now," but when that engineer was told Ferranti's age, he was dumbfounded that a young man of 20 or thereabouts could have conceived and carried out such stupendous work. It was a very great pity that the electrical industry in this country did not take advantage of Ferranti's genius and so get a start of all the other countries in the world. That was entirely due to Government legislation. Other countries copied Ferranti's ideas and benefited accordingly. Young engineers to-day could have no idea of the difficulties of those early days. Night after night, and all night, breakdown succeeded breakdown, and on one occasion out of six machines, five had failed in one day, leaving only one to give a very partial supply. But working with a man like Ferranti—and he had proved himself to be a man—his charm of manner and great personality put new life into his assistants, and owing to his genius and forethought and courage, the difficulties were overcome one by one. If there had been a medal for valour in those days similar to the much coveted Victoria Cross, Ferranti would surely have been given it for his courage and perseverance in the face of enormous difficulties. There was, however, a medal given by the Institution which conferred the highest possible honour it could give and everyone would be agreed that in giving the Faraday Medal to Dr. Ferranti it was being given to one who was in every way worthy of it.

The PRESIDENT (Dr. Alexander Russell) said that Dr. Ferranti in his presidential address in 1910 had advocated the use of electricity everywhere and for everything. During the 36 years that he had known Dr. Ferranti, no one had striven harder or more successfully to advance electrical science in its applications. As those were the objects for which the Institution was founded it was but natural that they should delight in honouring Dr. Ferranti, and in the name of the Institution he presented the Faraday Medal.

DR. S. Z. DE FERRANTI, on rising to receive the Medal, was given a most cordial reception. He said he could not express how deeply he appreciated the honour that had been done him and he valued it all the more for the way in which it had been presented. He was delighted that it should have been handed to him by Dr. Russell, he was delighted that the Council should have chosen Col. Crompton and Mr. Partridge—two of his old friends—to speak, and he was delighted that it was a medal bearing the name of Faraday. Going back to the early days that had been spoken of, he said he had never forgotten the very great benefit he had received from Col. Crompton at that time, because he was the primary source of information with regard to the making of electric light. That might sound ridiculous to-day when they hardly knew of anything but electric light, but in those early days it was the rarest thing to see electric light and very difficult for anyone not actually in the work to get information about it. Col. Crompton and his assistants freely showed him all that they were doing and gave him the first chance of acquiring knowledge. Later on he derived the greatest possible help from being allowed, as a boy, to work with Mr. Sydney Baynes, chief assistant to Col. Crompton in the installation of electric light at King's Cross terminus. He was up from school at the time and he was in the seventh heaven at being allowed to be associated personally with such an undertaking. He thanked Col. Crompton most sincerely for the way in which he and his assistants helped him at the very beginning.

A presentation of that kind involved personal recollections and he had asked Mr. Partridge before coming to the meeting whether he remembered an occasion 36 years ago to the day, which was his (Dr. Ferranti's) wedding day. Mr. Partridge was there, and so were Mr. C. P. Sparks and Mr. Colley, both of whom he was pleased to see were present that evening. He felt it was a curious coincidence that Mr. Partridge should be one of the speakers that evening. Such things were stranger than things one read about. He was also delighted to see so many old friends present, because he was sure they had made a point of coming there out of kindness on account of the presentation.

With regard to the presentation, and why it was being made, as they all knew he had striven for a very long time to increase the applications of electricity, and he took the medal as compensation for his failures and as an encouragement to further work in the same good cause. It was real encouragement, and he hoped it would spur him on to do something more useful. He wished to remind them all, as he had endeavoured to do in his Presidential Address of 1910, that they could not have too much electricity. They wanted it everywhere and had not anything like enough of it. In that Address he had attempted to show what should be done and the course that should be followed. But, although electricity had gone very far and its application was enormous, the progress since 1910 was somewhat disappointing. He felt that that was largely due to the fact that there had been no fundamental reduction in the cost of generating electricity. The cost of generating electricity was only one thing. There was the cost of distribution and the capital involved in supplying the user, but if there could have been a great step forward in the way of increasing the efficiency of turning coal into electricity, a far greater advance would have been made. It was up to the members of the Institution and other scientific workers in the world, of which there were now great numbers—unlike what it was when he and Col. Crompton were first engaged in this work—to try and advance the applications of electricity; what was most wanted was to be able to generate more efficiently and to transmit at less cost. Electricity supply had become a very complicated business and he felt that in the future there must be some radical alteration

greatly simplifying the whole process. He would like to remind electrical engineers generally that their work along one line alone would only be approaching completion when there was no more combustion carried on for power or heat within populous areas. His gas friends, he knew, would not agree with him, but he had thought over the matter at great length; he had considered it in many ways and for a long time. He had spoken on those lines before, but after all he was more than ever persuaded that eventually they would use electricity for all the services which now were served through the burning of some kind of fuel within populous areas. Such an effect would be very great. Electricity was the great labour saver, but electricity under those conditions would be an immensely greater labour saver and would enormously lighten a great deal of the disagreeable work of the world. He was convinced that discoveries would be made and turned to useful account which would largely enable them to generate electricity more efficiently, *i.e.*, at a lower cost, and so bring in its train other simplifications connected with electricity supply and make such a system that electricity could be furnished for all their wants. This sort of idea had been his life's work and so long as he could continue to work, he hoped to work on those lines, and what he failed to accomplish himself—and he could only accomplish very little—he would hope to encourage others to do and so excite their interest that they would work at the subject and eventually bring it to success, by giving electricity to all the world to its undoubted great advantage.

Dr. Ferranti concluded by again expressing his sincere appreciation of the honour done him in awarding him the Faraday Medal, and was given a great ovation.

Correspondence.

Correspondents should forward their communications **at the earliest possible moment.** *No letter can be published unless we have the writer's name and address in our possession.*

The Single-phase Induction Motor and the Starting Problem.

With reference to Mr. E. J. Timberlake's letter on the above subject in your issue of April 18th, we are generally in agreement with him in his remarks, but we think that his letter may convey the impression that the single-phase shunt commutator motor has been developed by the Electro-Dynamic Construction Co., Ltd.

This, of course, is not the case, as this type of machine has been developed by Mr. F. Creedy, and it was only after the expiration of his original master patent, granted in 1906 (which expired in 1922 after an extended life of sixteen years), that the Electro-Dynamic Construction Co. was able to introduce a machine of this type.

The Creedy single-phase shunt commutator motor has been undergoing continual development since 1906, and has been continuously on the market for over twelve years. Subsequent patents have been granted to Mr. Creedy as a result of improvements which he has made during this period.

In view of the large amount of work done by Mr. Creedy on this subject over a considerable period of years, it is only fair, we think, that it should be acknowledged that the credit for developing this very valuable type of machine is due to him.

We have been associated with the Creedy motor for the past ten years, during which time the use of this type of machine, in preference to other single-phase motors, has developed very rapidly. It is only a matter of time for the split-phase induction motor to become obsolete.

Pooley & Austin.

Westminster, *April 23rd*, 1924.

The "Correspondence" columns of the Electrical Review for the past few months have contained some most illuminating and interesting letters, germane to this subject. Your issue of April 18th, 1924, contains a useful contribution from Mr. E. J. Timberlake. To-day we find quite a number of supply authorities faced with the necessity of finding a solution of a more satisfactory nature than that offered by the squirrel-cage single-phase motor (with what Mr. Bedford might term "idiosyncrasies"). Its poor power factor and low starting torque are the foremost of its shortcomings.

I submit that the commutator a.c. motor is to-day the most promising solution of the problem. I only know of two English firms which are tackling the problem on a commercial basis.

In the Review of 25th inst. Mr. N. Pensabene-Perez writes *apropos* of this subject from the educational point of view. But who does Mr. Pensabene designate the "operating engineer?"

When "Mr. Snobber" decides to apply "Lectric" to his boot-finishing machine, he calls in an installation authority or contractor, waiving for the nonce Mr. Pensabene's concluding paragraph on the student. Would it surprise the author of the letter referred to to hear that within the last 12 months he, the author, invited a so-called installation engineer to visit the author's works to be convinced? The party invited called by appointment, and was not convinced by the demonstration, which proved little more than a fiasco. I would suggest that before the Electro-Dynamic Construction authorities attack the technical schools, they, the E.D.C. Co., at least provide more conclusive evidence in support of their claims than was forthcoming when I visited New Cross Road.

Quite a number of the installation engineers of to-day had their first a.c. commutator experience something as follows:

Scene: 12.15 a.m. at the borough of X electricity works.

Five out of eight rectifiers (the product of that genius we all honoured last Thursday night) being run by a.c. single-phase commutator motors, when suddenly the hind leg of a gnat gets into the circulating water, or a catastrophe of similar magnitude upsets the reciprocators driving the alternators. Curtain!

Simple educational convincing evidence is necessary before the purchasers of a.c. commutator motors will generally and universally believe that at light load a leading power factor can be obtained from the above type of apparatus. The supply authority will then in turn begin to realise that cheaper electricity is in sight.

W. E. Rogers, A.M.I.E.E.

London, *April 27th*, 1924.

What is Electricity?

As one who was present at the reading of Mr. Yerbury's delightful paper on the above subject, I should like to assure Mr. Massey that there was no question of "leg pulling." It is to be hoped that the wide publicity given to the paper in your columns will produce adequate criticism. It is a subject fully worthy of the deepest thought.

By the way, it should be made clear that the wave and plank story quoted by me in the discussion is a happy illustration used by Sir Wm. Bragg when dealing with the complex and apparently mystifying phenomena characteristic of the electron.

D. G. Jones.

Sheffield, *April 24th*, 1924.

Some Ill-Considered Aspects of Trading Agreements.

My attention has been drawn to an article under the above heading which appeared in your issue of 18th inst.

If your correspondent refers to the clauses of the Draft Report submitted to a meeting of manufacturers, factors, and contractors interested in fair trading, recently held in Glasgow, I would point out for the information of your readers in general, and for that of your correspondent in particular, that the criticism contained in the article referred to is premature, and ill-advised, in respect that the report is still under consideration and has not yet been approved.

As "Just Bide A Wee" although professing to be well versed in trading agreements seems to have only grasped certain points in the report and failed to appreciate others, I may say my committee will welcome an interview with him to discuss "Fair Trading" in all its aspects, provided he can satisfy them that such a meeting would be beneficial to all interested.

P. Armour,
Secretary, Joint Committee on Fair Trading.

Glasgow, *April 28th*, 1924.

Legal.

Loud-speaker Obstruction.

Mr. Gordon E. Ward, an electrical manufacturer carrying on business in the City, was summoned before Alderman Sir John Baddeley at the Mansion House on April 23rd for causing an obstruction in St. Paul's Churchyard on April 3rd. He pleaded "Not guilty."

The case for the police was that the defendant was seen by a constable standing on the footway with portable radio apparatus and a loud-speaker, causing an obstruction, and he refused to go away. He was therefore taken to Snow Hill police station.

The defendant's apparatus was produced in Court, and it was suggested that they might hear the King's speech at Wembley through it. This was allowed, and the closing passages of his Majesty's speech and the cheering were distinctly heard all over the Court.

The defendant said that a Press agency had asked him to be photographed with the apparatus outside St. Paul's.

Alderman Sir John Baddeley thought that the constable had exhibited a little excess of zeal in removing the defendant. It was only a technical offence, and he should merely ask the defendant to pay the costs—4s. 6d. He would not record a conviction in that event.—*The Times.*

Reviews.

Practical Tests for the Electrical Laboratory. A Text Book for Engineering Students. By C. H. Johnson, M.E., and R. P. Earle, B.S., M.E. Pp. vii+347. Figs. 64. London: Constable & Co., Ltd., 1923. Price 16s. net.

This is an American text book intended to cover the practical electrical work done by students of average industrial high school or trade school ability. It would fall more accurately under the heading of Laboratory Instructions, as one can hardly describe as a text book a series of experiments ranging from wire-gauging to electric welding. Reading and lectures on electrical theory are expected to run parallel to this practical course, and consequently only such theoretical matter as may be directly applied to the experiment is given. References to a comprehensive list of books are intended to supplement the work and provide a broader point of view.

Books of this type may serve a useful purpose in the vocational schools of the United States but are of very doubtful utility in this country. One will fear for the initiative and originality of our technical lecturers when they conduct their practical classes by handing out stereotyped instructions such as are collected here. Not that we would say aught against the use of carefully worded instruction sheets in physical and other laboratories. But we would strongly deprecate the tendency to turn students loose in a laboratory with a sheet of instructions and some apparatus and the idea that if they collect the said apparatus, make certain connections and tabulate the results, all wisdom and knowledge will be theirs.

The reviewer remembers spending some unproductive days under a system of instruction which tended in this direction. Fortunately, one day, by the inadvertent use of the wrong instruction sheet with the right machine, many things were done that had been better left undone and much heat, both physical and metaphorical, was generated. The result was a wiser use of instruction sheets and a revision of the opinion that an instruction sheet in the hand is worth any number of instructors lurking in obscure corners of the laboratory. The moral of all which is that such a book as this *might* serve a very good purpose if it were well handled by a competent instructor but, on the other hand, it might be a soul and science-killing device under less favourable circumstances.

Having said so much in criticism we come to the more amiable task of complimenting the authors upon the very complete course of electrical laboratory work outlined in this volume. The general arrangement is admirable, and it is evident also that great care has been taken to make the notes and theory attached to each experiment as complete as possible. We would refer especially to the experiments on controllers and measuring instruments in the d.c. section and to transformers in the a.c. section.

The references throughout the book are full and definite, the diagrams are clear, and there is a commendable absence of the useless type of catalogue illustration. The somewhat high price will hardly encourage a wide circulation in this country.

Organisation and Administration of the Tramways Department. By S. B. N. MARSH, accountant to the Birmingham Corporation Tramways. Pp. vii+163. London: Sir I. Pitman & Sons, Ltd. Price 6s. net.

This book is one of "Pitman's Municipal Series," edited by Mr. W. Bateson. As a treatise on municipal tramways accountancy, based on the practice of one of the larger undertakings, it can be thoroughly recommended. The title is wider than the contents justify. As a general rule it is desirable that the titles of technical books should indicate the limits of the treatment, and the author and editor might well have considered this point, for the organisation and administration dealt with excludes some divisions which are at least of equal importance with good accountancy.

The system of accounts and returns explained and illustrated by a full set of forms has every appearance of being well thought out and co-ordinated. For such an undertaking as a municipal tramway system it is not sufficient that the accounts should constitute a true record of the financial transactions and working, with the necessary detail and vouching to establish responsibility throughout, though this is the first essential. Internally it is necessary that the management vested in the committee and general manager should have before them at regular short intervals statements combining statistical and financial information showing how the undertaking is doing to date, and guiding them in the control of the working. Externally the Ministry of Transport requires annual returns, partly statistical and partly financial, and other summaries are required for income tax and rating assessments. It is important that the accounts system shall afford the necessary information without laborious dissection. The short-period statements for the management may in fact anticipate the book entries, and economy of labour is secured by making the same material serve for both purposes.

These requirements seem to be well met by the system set out by Mr. Marsh, though one would have welcomed an example of the periodical (weekly or four-weekly) statement tendered to the Committee, with references to the sources of the items in the other forms and accounts.

It would be outside the scope of these columns to criticise or comment upon the system from the strictly technical accountancy standpoint. The tramway business has the peculiar feature that its revenue is made up of a very large number of very small sums, and to bring these into account necessitates a system which must be somewhat minutely detailed, and yet as nearly as possible automatic and self-checking. The requirements are met by the methods set out by Mr. Marsh.

One small detail raised a query in the mind of the reviewer with respect to the assessment for rating, page 38. The allowance on the hypothetical tenant's capital is given as 17½ per cent. of the net receipts, with the proviso that the percentage is considered too high by some and too low by other assessors. This is not always the method adopted, a valuation is made of the tenant's capital (mainly cars and plant for their maintenance), and the amount required for maintenance and the return on that capital is taken as the tenant's share. Probably the 17½ per cent. has been arrived at by some such calculation, but a word of explanation to this effect might have been given. The valuation for income tax assessment is very clearly set out.—H. M. S.

Published Specifications.

Compiled expressly for this journal by MESSRS. SEPTON-JONES, O'DELL AND STEPHENS, Patent Agents.
The name of the applicant's patent agent, if any, will be found on the printed specification.
The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1922.

26,368. "Telephonic receiving apparatus." A. E. Graham. September 29th, 1922. (213,622.)

27,090. "Electric headlamps for motor-cars and other like lamps." W. E. Marshall and P. G. P. McCulloch. October 6th, 1922. (213,623.)

27,091. "Electric headlamps for motor-cars and other like lamps." W. E. Marshall and P. G. P. McCulloch. October 6th, 1922. (213,624.)

35,403. "Electric telegraph systems." F. E. Pernot, H. V. Higgitt, and Eastern Telegraph Co., Ltd. December 29th, 1922. (213,651.)

35,489. "Insulators for supporting high-tension transmission cables and the like." R. J. P. Briggs, H. S. Newman, and Bullers, Ltd. December 30th, 1922. (213,655.)

1923.

97. "Electrically-driven vehicles." J. B. Parker. January 1st, 1923. (213,658.)

233. "Electrical installation allowing remote control of at least one indicating instrument, such as an apparatus showing the rates of exchange." Favarger et Cie. Soc. Anon. January 19th, 1922. (192,055.)

341. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. (Automatic Electric Co.). January 4th, 1923. (Addition to 211,189.) (213,663.)

459. "Resistance coils." N. Ashbridge. January 5th, 1923. (213,675.)

461. "Telephone systems." Relay Automatic Telephone Co., Ltd., and B. B. Johnson. January 5th, 1923. (213,676.)

462. "Telephone systems." Relay Automatic Telephone Co., Ltd., and B. B. Johnson. January 5th, 1923. (213,677.)

463. "Switching apparatus of automatic and semi-automatic telephone systems." Relay Automatic Telephone Co., Ltd., and B. B. Johnson. January 5th, 1923. (213,678.)

481. "Electric arc lamps." P. Rigby. January 5th, 1923. (213,681.)

767. "Vacuum tubes of the three-electrodes type." F. Peri. October 7th, 1922. (205,039.)

898. "Transformers for thermionic valve amplifiers." C. Lorenz Akt. Ges. February 11th, 1922. (193,010.)

899. "Electric motors." W. H. Scott. January 10th, 1923. (213,692.)

1,133. "Armoured electric cables." J. B. Gall and Callender's Cable and Construction Co., Ltd. January 12th, 1923. (213,697.)

1,179. "Marine signal lights." C. G. Rask. January 13th, 1923. (Cognate application, 21,128/23.) (213,698.)

1,232. "Radio receiving circuits." P. G. A. H. Voight. January 15th, 1923. (213,699.)

1,353. "Electric transformers, induction coils, and the like." W. D. Bureau. January 15th, 1923. (213,700.)

1,962. "Sparking plugs." F. Reynolds, H. D. H. Drane, and Thermal Syndicate, Ltd. January 22nd, 1923. (213,710.)

2,066. "Electric flat irons." W. T. Hoofnagle. January 23rd, 1923. (213,712.)

2,759. "Sound receivers, particularly for receiving sound waves in liquids." Signal Ges. February 1st, 1922. (Addition to 172,637.) (192,696.)

2,792. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. May 10th, 1922. (Addition to 163,807.) (197,643.)

3,379. "Multi-speed induction motors." L. J. Hunt and Sandycroft, Ltd. February 5th, 1923. (Cognate application, 25,357/23.) (213,725.)

5,867. "Manufacture of storage batteries." G. Shimadzu. February 20th, 1923. (Convention date not granted.) (198,647.)

11,495. "Miners' electric hand lamps." A. H. Railing, J. Stanley, and A. E. Angold. April 28th, 1923. (213,784.)

11,594. "Electric luminous discharge lamps." General Electric Co., Ltd. January 20th, 1923. (210,035.)

15,249. "Telephone receiver." H. Bruckner. June 11th, 1923. (213,801.)

16,145. "Electric water-heating apparatus." E. Demole. June 22nd, 1922. (199,731.)

18,076. "Shades for the headlamps of motor road vehicles." R. Mostyn. July 12th, 1923. (213,820.)

18,711. "Control systems for dynamo-electric machines." Metropolitan-Vickers Electrical Co., Ltd. (Westinghouse Electric and Manufacturing Co.) July 20th, 1923. (213,822.)

21,998. "Switching devices for use in telephone exchange systems." Western Electric Co., Ltd. (Western Electric Co., Inc.). August 31st, 1923. (213,833.)

23,244. "Electric fluid heaters." R. N. Patterson, F. S. Patterson, and J. H. Patterson. September 17th, 1923. (213,838.)

1924.

1,866. "Electric power and distribution systems." Metropolitan-Vickers Electrical Co., Ltd. January 23rd, 1923. (210,433.)

3,579. "Thermo-electric couples." C. P. Miller. January 5th, 1923. (Divided application on 213,350.) (213,868.)

6,518. "Magneto electric machines." M.L. Magneto Syndicate, Ltd., and E. A. Watson. January 10th, 1923. (Divided application on 888/23.) (213,87[illegible].)

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